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REPORT OF THIRTY-NINTH ANNUAL MEETING OF THE OHIO ACADEMY OF SCIENCE

WILLIAM H. ALEXANDER,
Secretary

The Ohio Academy of Science met in its Thirty-ninth Annual Meeting under most fortuitous circumstances; on the charming campus of historic old Wittenberg, in the delightful city of Springfield, famous for its beautiful homes. The meetings were held on Friday and Saturday, April 26 and 27, 1929, under the presidency of Prof. James S. Hine. The Wittenberg authorities including President Tulloss, Dean Shatzer, and a most efficient local Committee headed by Dr. W. C. Beaver, left nothing undone for the comfort and pleasure of the visitors the result being that after two days filled with happy associations all came away feeling definitely enriched intellectually, with a larger outlook on life, and more deeply inspired to attempt greater things in the future.

The attendance was unusually good, the spirit of optimism never more general or more evident, the programs never more balanced or satisfying, nor the papers on the whole of greater excellence. All showed a high degree of forethought and wisdom on the part of the vice presidents.

The banquet on Friday evening was a real event. The "S.R.O." sign was hung out long before the feast began; it was said that at least 300 were seated at the banquet tables. The flowers were profuse and beautiful (thanks to the *Xi Chapter of Beta Beta Beta* Biological Fraternity!), the menu highly satisfying, the music delightful, the words of welcome on the part of President Tulloss of Wittenberg College and Superintendent Shelton of the Public Schools most gracious and very pleasing, the response by President Hine to the words of welcome appropriate and sincere, and the introductory

remarks by the toastmaster, Dr. S. R. Williams of Miami University always to the point and frequently full of wit and humor! What more could one ask in the way of a banquet!

Following the banquet and in the same hall, occurred the showing of the famous *Canti Film*, a moving picture demonstration of living cells in growing culture, secured for the occasion by Dr. Raymond C. Osborn, who was scheduled to make the introductory and explanatory remarks in connection with the demonstration but owing to a temporary physical weakness at the time asked Dr. J. Paul Visscher of Western Reserve University to "pinch hit" for him, which Doctor Visscher did in a most acceptable manner. The impressions made by the film and the explanatory remarks by Doctor Visscher were profound and unforgetable.

The general program of the meeting was as follows, viz:

FRIDAY, APRIL 26.

9:45 A. M.—Business meeting.

10:30 A. M.—Scientific lectures and papers in general session.

1:30 P. M.—Scientific lectures and papers in sectional meetings.

6:30 P. M.—Banquet, Shawnee Hotel. Greetings by President Tulloss of Wittenberg College and by Superintendent F. M. Shelton, Springfield Public Schools, with response by President Hine.

8:00 P. M.—Showing of the Canti Film, with introductory and explanatory remarks by Dr. J. Paul Visscher of Western Reserve University.

SATURDAY, APRIL 27.

9:00 A. M.—Adjourned business meeting.

10:00 A. M.—Presidential Address on "The Distribution of Ohio Mammals by President James S. Hine, Ohio State University, followed by the showing of a motion picture film depicting "The American Eagle in Action" by Dr. Francis H. Herrick of Western Reserve University, author of the film, (2,000 feet).

1:30 P. M.—Scientific lectures and papers in sectional meetings.

MINUTES OF THE BUSINESS AND GENERAL MEETINGS.

The business meetings of the Thirty-ninth Annual Meeting of the Ohio Academy of Science were held in the auditorium of the Chemistry-Psychology Building, Wittenberg College, Springfield, Ohio.

The first session was called to order by President Hine at 9:50 A. M., on Fiday, April 26, 1929, with about seventy-five members present.

The President announced the following committee appointments, viz:

Committee on Membership—Wm. C. Beaver, Wittenberg College; G. W. Conrey, Ohio Agricultural Experiment Station; and Ralph V. Bangham, College of Wooster.

Committee on Resolutions—F. C. Waite, Western Reserve University; Albert P. Mathews, University of Cincinnati; and S. R. Williams, Miami University.

Committee on Necrology—Frederick C. Blake, Ohio State University and August Foerste, Dayton High School.

Then followed the reading of the reports of the officers. The report of the Secretary was read, accepted and ordered filed. The Treasurer being absent from the State, asked the Secretary to read a brief, informal statement of the Academy finances to which Dr. E. N. Transeau and Mrs. Ethel M. Miller added a word of explanation, all tending to show that the Academy is on a very satisfactory financial basis at this time, there being a probable balance after all bills are paid of between four and five hundred dollars. The Treasurer promised a complete, detailed report immediately upon his return to the State, in time for inclusion in the Proceedings.

The next item of business was the election, by ballot, of an *Auditing Committee.* Dr. E. N. Transeau and Dr. F. H. Krecker were placed in nomination and the Secretary was directed to cast the unanimous ballot of the Academy for the nominees which was done and they were declared elected.

Then followed the reports of the standing committees, in the following order, viz:

(a) *The Executive Committee;* report read by the Secretary.

(b) *The Publications Committee:* the chairman, Prof. F. O. Grover, Oberlin College, was absent and no report was made.

(c) *The Trustees of the Research Fund:* the report was read by the chairman, Dr. Herbert Osborn, Ohio State University.

(d) *The Library Committee:* the report was presented by Mrs. Ethel M. Miller, an assistant librarian, Ohio State University, and a member of the Committee.

The President then called for the election by ballot of a *Nominating Committee* of six, one from each section. The fol-

lowing were placed in nomination, the nominations ordered closed and the Secretary instructed to cast the unanimous ballot of the Academy for the nominees, viz:

A. *Section of Zoology*—RALPH V. BANGHAM, College of Wooster.
B. *Section of Botany*—HUGH M. RAUP, Wittenberg College.
C. *Section of Geology*—PARIS B. STOCKDALE, Ohio State University.
D. *Section of Medical Sciences*—SHIRO TASHIRO, University of Cincinnati.
E. *Section of Psychology*—MARTIN L. REYMERT, Wittenberg College.
F. *Section of Physical Sciences*—E. O. WEAVER, Wittenberg College.

The hour having arrived at which the reading of scientific papers in a general session of the Academy was scheduled to begin, it was moved by the Secretary that the business session adjourn to meet again at 9:00 A. M. the following day, Saturday, April 27, 1929, which motion prevailed and the first business meeting was declared adjourned at 10:35 A. M.

The general session was called to order by the President at 10:40 A. M. and the following interesting papers were presented, viz:

1. Life Challenges Science, by DAVID DIETZ, Science Editor, Cleveland Press.
2. S. P. Hildreth: Pioneer Biologist of Ohio, by H. R. EGGLESTON, Marietta College.
3. Parasites of Commercial Fish of Lake Erie, by RALPH V. BANGHAM, College of Wooster.
4. The Application of X-rays to the Study of the Structure of Crystals, by FREDERICK C. BLAKE, Ohio State University.
5. Thermophilic (Heat-loving) Bacteria, Including Their Distribution, Methods of Isolation and Identification, by W. C. BEAVER, Wittenberg College.

Dr. F. C. Waite of Western Reserve University in discussing paper number two pointed out the fact that the great majority of the early scientists received their training in medical schools.

The first general session was adjourned at 12:10 P. M.

(Reference is made in the introductory portion of these proceedings to the evening banquet and program).

The second business meeting of the Academy was called to order by President Hine at 9:00 A. M. sharp, Saturday, April 27, 1929, with about one hundred members present.

The reading of the reports of standing committees was resumed and the report of the *Committee on State Parks and Conservation* was read by the chairman, Dr. Herbert Osborn, Ohio State University.

Then followed the reading of the reports of special committees in the following order, viz:

(a) The report of the *Committee on the Election of Fellows:* report read by the Secretary.

(b) The report of the *Nominating Committee:* report read by the chairman of the committee, Dr. R. V. Bangham, College of Wooster.

(c) *The Committee on Membership:* report read by the chairman of the committee, Dr. W. C. Beaver, Wittenberg College.

(d) *The Committee on Necrology:* the committee was not ready to make a full and satisfactory report owing to the shortness of the time and lack of sufficient data; it asked for and was given an extension of time, promising to have a complete report in the hands of the Secretary in ample time for publication in the proceedings. The Secretary read a list of those known to him as having departed this life and asked that if members knew of any others that the names be given to the committee.

(e) *The Auditing Committee:* Inasmuch as the Treasurer made no report, the only matters referred to this committee for consideration were the reports of the Trustees of the Research Fund and of the librarian, Mrs. Miller, on the sale of Academy publications. The committee therefore requested and was granted further time, when a complete audit can be made.

(f) *The Committee on Resolutions:* report read by the chairman, Dr. F. C. Waite, and may be found elsewhere in this report.

Unfinished business was now called for and the Secretary presented to the Academy the recommendations coming from the Executive Committee, viz:

1. That Mr. George T. Spahr be elected a Patron of the Ohio Academy of Science, because of the "important favors" he has bestowed upon the Academy. Upon motion duly made and seconded, the recommendation was heartily and unanimously approved by the Academy.

2. That a committee of three be appointed by the President to consider the advisability and the ways and means of establishing facilities for encouraging junior scientific effort in Ohio and report with recommendation at the next annual meeting of the Academy.

After some discussion by Prof. Geo. D. Hubbard, of Oberlin, and others, it was unanimously voted to approve the recommendation.

Under the head of new business, the President called upon Dr. Herbert Osborn, the official representative of the American Association for the Advancement of Science, to present whatever message or word he might have to offer concerning the relations now existing between the two organizations. Doctor Osborn said, in part:

In addition to bringing the greetings of the National Association, I feel that there are a few matters that might properly be mentioned concerning the relations of the two organizations.

Speaking for the Permanent Secretary, I wish to call attention to the desirability of our members becoming members of the Association and of all Association members living in Ohio becoming members of the Ohio Academy of Science and thus add strength to both organizations in their efforts to promote Science in the State. Why not invite those members of the Association in Ohio not now members of the Academy to attend our meetings and enjoy the privileges of membership in the Academy?

The Academy Conference recently organized with the hearty sanction of the Council of the A. A. A. S., and more or less under the leadership of our own secretary, composed as it is of one representative from each of the affiliated academies and three members from the Association-at-large, serves as an excellent clearing-house between the two organizations and ought to afford an excellent means of cooperation and interchange of helpful ideas and suggestions among the state academies, possibly leading to joint meetings of neighboring state academies. The possibilities are great and the Association is very anxious to encourage and help the Conference in every way possible.

Our members are and should be, of course, interested in the fact that the Association is to meet in Cleveland in 1930 and will certainly want to do everything they can to assist the local committee in its plans for that meeting. Also, it is hoped there will be a large delegation from Ohio at the Des Moines meeting next December. Begin to make your plans now.

It is impossible, of course, in a moment of time to point out the many and material advantages of the affiliation between our Academy and the Association but no doubt the many ways in which the two may be of mutual service to each other will occur to you.

The President then called upon Prof. Eddy, as the representative of the South Carolina Academy, for remarks, but he was not present at the moment.

The Secretary reminded the Academy that the Kentucky Academy of Science was in annual session at this time at Berea, Kentucky, and suggested the sending of greetings. Upon motion the Secretary was instructed to send such greetings and, at the suggestion of Prof. J. Ernest Carman, the West Virginia Academy of Science, also in annual meeting, was included in the greetings.

The election of a delegate to the Council of the American Association for the Advancement of Science was brought up by the Secretary and upon motion duly passed was referred to the Executive Committee with power.

The selection of the time and place of the next annual meeting was also referred by unanimous vote to the Executive Committee with power.

Dr. E. N. Transeau, of Ohio State University, then offered the following motion, which was seconded by several, viz:

> That a committee of six members, one from each of the six sections, be appointed by the President to look into the matter of a more adequate publication of the proceedings of the Academy, and of the Academy's relation to the Ohio Journal of Science, and report with recommendation at the next annual meeting of the Academy.

The motion provoked considerable and at times rather animated discussion by several members and when finally put to a vote was unanimously carried.

At 10:00 A. M., the business meeting was adjourned *sine die* and at 10:15 A. M. a general session of the Academy was called to order by President-elect F. C. Waite, who in a very happy way introduced President James S. Hine. President Hine then delivered the presidential address on the subject, "*The Distribution of Ohio Mammals.*" Following this address, Dr. Francis H. Herrick, of Western Reserve University, was introduced and presented in a very pleasing way a motion picture film, some 2,000 feet in length, made by himself and assistants, showing "*The American Eagle in Action.*"

REPORTS

Report of the Secretary

SPRINGFIELD, OHIO, April 26, 1929.

To the Ohio Academy of Science:

Fortunately and necessarily, the content of the secretary's report is a variable. He may include many or few of the details of his official duties during the year and he may say much or little about these details. To report all details would be deadly; to select wisely ought to be helpful and stimulating. The wise course at this time seems to be the omission of the great mass of details. Hence a short report.

In general, the details were very numerous, the work slightly irksome at times, but on the whole delightful. The members have been exceedingly courteous, considerate and appreciative; could not have been

more so; therefore, it is with the greatest pleasure that we again record our deepest gratitude for the continued loyal and sympathetic support of the membership. Every call upon the office received prompt, courteous and as far as we were able efficient consideration, our *one aim being service with courtesy.*

Of course the first task after the Cincinnati meeting was the compilation and publication of the proceedings of that, the 38th annual meeting of the Academy. The report of the 38th annual meeting contained three rather important innovations: first, the omission of the membership list; second, a list of current exchanges of the Academy deposited in the Ohio State Library, carefully compiled and ably edited by our efficient librarian, Mrs. Ethel M. Miller; and third, abstracts of 47 out of the 79 or so papers and addresses given at the meeting. This last mentioned innovation has received very favorable comment, so much so that it has been decided to repeat it this year. The secretary wishes here and now to congratulate the authors of these abstracts; many of them are obviously the work of experts. Note also that the report was much larger than usual. A very brief résumé of the Cincinnati meeting was also published in *Science* for May 25, 1928, (Vol. LXVII, No. 1743, page 538). The third Cincinnati meeting (38th Annual) was one of rare excellence in many ways, out of it grew a great store of fragrant, abiding memories carried away by those fortunate enough to enjoy the real Cincinnati hospitality, contributed to so generously by one whose sweet, quiet, modest spirit would doubtless be with us today but for an inexplicable, tragic element in human affairs that has forever robbed us of his benign presence and wise counsels! To be sure the appropriate committee will guide us in the proper action we should take to honor the memory of our late president, *Dr. Harris M. Benedict,* but the writer could not refrain, because of a year's delightful associations and helpful cooperation, from placing on record a sincere tribute to the sacred memory of a *friend.*

Immediately upon receipt of the news of the tragic death of Ex-president Benedict, the President, the Treasurer and the Secretary held a conference at which it was decided that the Academy should be officially represented at the funeral services in Cincinnati and the Treasurer, Dr. A. E. Waller, was selected and agreed to go, which he did. A few days later Dr. Waller received the following letter from Acting Dean M. J. Hubert of the College of Liberal Arts, viz:

CINCINNATI, OHIO, November 1, 1928.

DEAR PROFESSOR WALLER:

I should like you to know that we of the University of Cincinnati appreciate the visit that you paid us on the occasion of Professor Benedict's funeral. We were honored by the action of the Ohio Academy of Science in sending its representative to Cincinnati. Your thoughtfulness and sympathy have helped us to bear the burden of a very great loss.

Sincerely yours,

M. J. HUBERT,
Acting Dean of the College of Liberal Arts.

Early in June of last year, the section of geology, again under the leadership of Dr. A. C. Swinnerton, of Antioch College, assisted by

Prof. J. Earnest Carman of Ohio State University and Prof. August F. Foerste of Dayton High School, visited the outcrops of the Devonian in the Bellefontaine outlier and the outcrops of the Silurian in the Dayton-Springfield regions, some 38 persons representing 13 institutions joining in the party. Doctor Swinnerton's report is as follows, viz:

FIELD TRIP OF OHIO GEOLOGISTS.

By A. C. Swinnerton, Antioch College.

The Annual Field Trip of the Geological Section of the Ohio Academy of Science was held in the vicinity of Dayton and Springfield, Ohio, on June 1, 2, and 3. Thirty-eight people representing thirteen institutions were in attendance.

J. Ernest Carman, of Ohio State University, and C. F. Moses, of Muskingum College, acted as guides on the first day of the excursion, when the party visited the outcrops of the Devonian in the Bellefontaine outlier.

On the second and third days August F. Foerste acted as guide, taking the party to outcrops of the Silurian in both the Springfield, Ohio, region and the area near the western boundary of the State.

Saturday evening at the Engineers' Club of Dayton, the group was addressed by Arthur E. Morgan, President of Antioch College, formerly chief engineer of the Miami Conservancy District, on the problems of flood prevention at Dayton.

A fifteen page mimeographed pocket field guide was published for the convenience of the members of the party. The booklet contained routes, sections to be visited, and a short account of the general relations of the formations.

The colleges and universities represented on the trip included: Antioch, Bowling Green, Kenyon, Miami, Muskingum, Ohio State, Ohio Wesleyan, Toledo and Wooster.

In March of this year the Secretary received a letter from Robert Underwood Johnson, Secretary of *The American Academy of Arts and Letters*, New York City, announcing that the Academy would celebrate the Twenty-fifth Anniversary of its founding on April 23 and 24, 1929, the purpose of said celebration being,

"to emphasize the significance of the Academy in advancing and preserving the ideals of letters and arts in the United States, as well as its close relations of association and interdependence with representatives of letters and the fine arts in lands other than our own. In particular we wish to emphasize the association and interdependence in the case of other academies."

The announcement closed with the hope that the Ohio Academy of Science would send a delegate to this celebration, or if no delegate, then a letter. After some correspondence with members of the Ohio Academy living in the vicinity of New York we finally secured Mr. E. E. Clayton, plant pathologist, now connected with the New York State Experiment Station at Riverhead, N. Y., to represent the Academy.

By permission of the Executive Committee, the Secretary again had the honor of representing the Academy on the Council of the A. A. A. S. at the New York meeting, last December, and acted as the chairman of the Academy Conference. We attended all the meetings of the Council except one or two, and several of the sectional meetings.

We have received, up to the present moment, 45 applications for membership which considerably more than overcomes the losses from deaths and resignations, so that we now have on the roll in the neighborhood of 575 members.

In closing, kindly permit the secretary to place on record his high appreciation of the fine spirit of cooperation shown by his fellow officers throughout the year and to congratulate the several vice-presidents on the excellence of the programs prepared for this meeting.

Respectfully submitted,

WILLIAM H. ALEXANDER, *Secretary.*

Report of the Treasurer.

COLUMBUS, OHIO, March 20, 1929.

Mr. W. H. Alexander, Secretary of The Ohio Academy of Science:

DEAR MR. ALEXANDER:—On the eve of my departure for a Western trip I wish to turn over to you a tentative account of my treasurership.

The bank balance as of March 8, is $1,124.82. This compares with a balance of March 31, 1928, when the balance was $1,258.25. Checks are coming in every day and I have left instructions to have these cared for in my absence. Our expenditures will probably not be very different from last year, and I expect we will show about the same total surplus of three or four hundred dollars after our expenses have all been met.

Please present my regrets to the members of the Academy for not being with them.

Sincerely yours, A. E. WALLER.

Report of the Executive Committee.

SPRINGFIELD, OHIO, April 26, 1929.

To the Ohio Academy of Science:

The Executive Committee, upon the call of the President, held three meetings during the year; one on December 8, 1928, at the office of the Secretary; one on January 12, 1929, at the Faculty Club, Ohio State University; and the third, last evening, at the Shawnee Hotel, Springfield, Ohio.

At the first meeting the following items of business were transacted, viz:

1. Six applications for membership in the Academy, all in proper form and on file with the secretary, were favorably acted upon and recommended for election at the next annual meeting.

2. Berthé Couch Koch, a former member, was restored to membership in the Academy.

3. Wittenberg College, Springfield, Ohio, was selected as the place and April 26 and 27 as the time for the 1929 annual meeting of the Academy.

4. Voted to reimburse the treasurer to the amount of Ten Dollars ($10.00), for expenses incurred in the course of his official duties.

At the second meeting, it was voted:

1. That Dr. R. C. Osburn be requested to correspond with Doctor Kofoid relative to securing of the *Canti Film* for presentation at the April meeting of the Academy.

2. Several distinguished names were suggested as suitable persons to make the invitation address at the annual meeting and the secretary was instructed to correspond with said persons, in turn, and see if one of them could be secured for the annual meeting. (This was done but all had previous engagements.—SECRETARY).

3. The committee heartily approved of the suggestion that special invitations be sent to all living charter members of the Academy whose addresses are known, and urge them to attend the Springfield meeting as the banquet guests of the Academy and that some special reference be made to them at the banquet.

4. It was unanimously voted to recommend to the Academy the election of Mr. George T. Spahr as a *Patron of the Academy.*

At the third meeting, it was voted:

1. That the 45 applications for membership in the Academy now on file with the secretary, all in due form, be recommended for election by the Academy to full membership.

2. That Mr. H. C. Shetrone, a former member, be restored to full membership.

3. To recommend to the Academy the appointment of a committee of three by the President to consider the advisability and the ways and means of establishing facilities for encouraging junior scientific effort in Ohio, and report with recommendation at next annual meeting of the Academy.

(This last recommendation is the result of or is based upon a special report by the secretary to the Executive Committee to the effect that at least two state academies, namely, North Carolina and West Virginia, are now doing something along this line, the former by offering a prize "for the best essay upon a scientific subject written by a high school student" on some theme selected by the student, the composition not to exceed 2,500 words; the latter (West Virginia), has two plans, one a loan of $100.00 to a senior or graduate student who is in need of funds to pursue some research problem, the loan to be returned without interest at a fixed date; the other plan is a prize of $25.00 for the best essay of 2,000 to 3,000 words on some assigned topic, the work in all cases to be performed under definite rules governing the contest).

Respectfully submitted,

WILLIAM H. ALEXANDER, *Secretary.*

Report of the Trustees of the Research Fund.

SPRINGFIELD, OHIO, April 26, 1929.

To the Ohio Academy of Science:

During the past year we have had no requests for grants to be paid within the year but requests have been made for allowances during the coming year.

The additions to the fund from interest receipts have amounted to $143.00; $48.00 on April 30, and $49.50, November 5, 1928, and $45.50 April 16, 1929.

Two hundred dollars ($200.00), have been placed in the interest-bearing fund and there is a checking balance of $62.91 which with

interest accruing in the next six moths will enable us to make small grants without drawing on the interent fund.

It may be noted that the entry of three interest payments results from the later date of the annual meeting this year. Also it may be noted that the research fund has grown from $1,362.91 in 1925 to $1,662.91 at present, and a total of $120 has been distributed in grants since the contributions from Mr. McMillin ceased.

SUMMARY.

Balance in checking account, April 7, 1928	$ 120.91
Receipt from interest as above	143.00
Total	$ 263.91
Invested in Certificate of Deposit	$ 200.00
Bank charge	1.00
Balance in checking account April 25, 1929	62.91
Total	$ 263.91

SUMMARY OF ASSETS, APRIL 25, 1929.

Bonds	$1,300.00
Certificates of Deposit	300.00
Balance in bank checking accounts	62.91
Total Assets	$1,662.91

(Signed) HERBERT OSBORN, *Chairman*,
EDWARD L. RICE,
GEO. D. HUBBARD.

Report of Mrs. Miller for the Ohio State University Library.

COLUMBUS, OHIO, April 23, 1929.

To the Ohio Academy of Science:

The work during the past year has been largely routine and hence there is not very much to be reported. Special Paper, No. 20, "Flora of the Oak Openings West of Toledo" by Prof. E. L. Moseley, was received soon after the annual meeting in 1928 and was mailed at once to 107 exchanges and to 12 botanical periodicals in this country and in Europe. In order to save the labor of addressing two sets of envelopes for the members of the Academy this Paper was not mailed to them until the Proceedings were received in July. The two publications were sent to 461 members and the Proceedings to 98 exchanges. Nine exchanges desire to receive only the Special Papers and a few have specified that they want only the botanical ones or the zoological ones. Hence it would seem as if the Special Paper for 1929-1930, No. 22, should represent some other section of the Academy besides the botanical section and should deal with geology, zoology or one of the other branches represented among the Academy members.

During this year seven new exchanges have been secured, two of them being State Academies, and three former exchanges have been resumed.

By agreement with the Business Manager of the Ohio Journal of Science, the Ohio Academy of Science librarian was relieved of the

task of caring for the sales of the individual numbers and volumes of the Journal. On July 31, 1928 a check for $157.75 was given to him for the sales of the Ohio Journal of Science from March, 1926 to the end of July, 1928, thus closing that account. On the same date a check for $146.25 was handed to the Treasurer of the Ohio Academy of Science for the sales of its publications from March, 1926 to the end of March, 1928.

The sales for this past year, April 4, 1928 to April 23, 1929, amount to $85.05, breaking all records for any single year. This sum will be given to the Treasurer after July 1, when the next dividend is due. With the addition of all the dividends, none of which have been withdrawn, the balance in the bank is now $103.61. The price list of the publications has been revised and will be off the press in a few days.

Respectfully submitted,

ETHEL M. MILLER

The following exchanges are additions and corrections to the list published in the Proceedings of the Ohio Academy of Science for 1928 by Mrs. Ethel M. Miller:

ARGENTINA.

La Plata. Obras completas y correspondencia cientifica de Florentino Ameghino.
Museo de La Plata (*).
Anales.
Revista.

BULGARIA.

Sofia. Société bulgare des sciences naturelles.
Travaux.

CANADA.

Ottawa. Department of agriculture.
Bulletins.
Circulars.
Pamphlets.
Reports.

CZECHOSLOVAKIA.

Prague. National museum.
Acta botanica bohemica.
Separates.
Charles university (*).
Fragmenta mycologica.
Mykologia.
Publications of the Faculty of sciences.
Studies from the Plant physiological laboratories.

GERMANY.

Berlin. Universität. K. Zoologisches museum.
Bericht.

MALAY STATES, FEDERATED.

Kualà Lumpur. Department of agriculture (*).
Bulletin.
Malayan agricultural journal.

POLAND.

Warsaw. Musée polonais d'histoire naturelle (*).
Annales zoologici.

UNITED STATES.

CALIFORNIA.

Berkeley. California. University (*).
Publications in entomology.

CONNECTICUT.

New Haven. State library.
Report.

ILLINOIS.

Springfield. Illinois state academy of science.
Transactions.

INDIANA.

Indianapolis. Indiana academy of science.
Proceedings.

IOWA.

Iowa City. Iowa. University (*).
Studies in natural history.

KANSAS.

Lawrence. Kansas academy of science.
Transactions.

OHIO.

Cincinnati. University. Institute of scientific research.
Papers.
Columbus. Ohio state archaeological and historical society.
Various duplicates.

WEST VIRGINIA.

Morgantown. West Virginia academy of science.
Proceedings.

Report of the Committee on State Parks and Conservation.

Springfield, Ohio, April 26, 1929.

To the Ohio Academy of Science:

Probably the most important items to report at the present time are with regard to the Legislation providing for a State Commission of Conservation with the Department of Agriculture and the National Legislation providing for permanent bird refuges to be established in different states throughout the country.

The State Commission for Conservation should provide a permanent organization directly interested in conservation measures and naturally including such matters as are of special interest to the members of the Academy. It is hoped when this organization is completed that we may be able to secure action and determine policies with regard to the state owned tracts included in the state forests, parks, refuges and other tracts which include features making them of value for the preservation of native fauna and flora and obtain definite assignments of areas as sanctuaries or permanently guarded tracts to insure such preservation. Your committee will endeavor to maintain such contacts with the commission as to provide opportunity for suggestions from members of the Academy, and to secure attention to measures promoting the preservation of native life.

While the committee does not claim credit for the specific legislation passed, we believe that the public interest and demand for such action has been stimulated through its efforts and by the influence of individual members of the Academy.

The National Legislation referred to should result in the acquisition of desirable tracts within Ohio, and it is believed that the administration of such tracts will promote the preservation of our native fauna and flora as well as the migratory birds particularly considered in the legislation enacted.

Cooperation with officers of the U. S. Biological Survey may assist in securing attention to points which are of special interest to our members.

The growth of interest in conservation measures among public spirited people of the state is certainly a very encouraging feature and it is hoped that members of the Academy will continue their activities in this direction.

(Signed) Herbert Osborn, *Chairman.*
E. N. Transeau,
E. Lucy Braun,
E. R. Hayhurst,
A. R. Harper,
Conrad Roth.

Report of the Committee on the Election of Fellows.

SPRINGFIELD, OHIO, April 26, 1929.

To the Ohio Academy of Science:

A meeting of the Committee on the Election of Fellows was held at the Shawnee Hotel, Springfield, Ohio, on the evening of April 25, 1929, as per the call of the secretary. A quorum of the committee was present with President Hine in the chair. The following persons whose nominations in due form had been filed with the secretary were unanimously elected, viz:

KENNETH CHARLES COTTINGHAM, Ohio State University.
EDWARD SAFFORD JONES, University of Buffalo.
RAYMOND E. LAMBORN, Ohio State University.
WILLIAM JOHN MCCAUGHEY, Ohio State University.
LEONARD BLAINE NICE, Ohio State University.
MARTIN L. REYMERT, Wittenberg College.
WARREN POPPINO SPENCER, College of Wooster.
SHIRO TASHIRO, University of Cincinnati.
LLOYD WILLIAM TAYLOR, Oberlin College.
CHARLES VERNON THEIS, University of Cincinnati.
OTTO CHARLES VON SCHLICHTEN, University of Cincinnati.

Respectfully submitted,
WILLIAM H. ALEXANDER, *Secretary.*

Report of the Nominating Committee.

SPRINGFIELD, OHIO, April 27, 1929.

To the Ohio Academy of Science:

Your committee on nominations submits the following report, viz:

President—FREDERICK C. WAITE.
Vice-Presidents:
A. *Zoology*—DWIGHT M. DELONG.
B. *Botany*—LEWIS H. TIFFANY.
C. *Geology*—PARIS B. STOCKDALE.
D. *Medical Sciences*—LEONARD B. NICE.
E. *Psychology*—MARTIN L. REYMERT.
F. *Physical Sciences*—FREDERICK C. BLAKE.
Secretary—WILLIAM H. ALEXANDER.
Treasurer—A. E. WALLER.
Elective Members of the Executive Committee—C. G. SHATZER, E. N. TRANSEAU.
Trustee, Research Fund—HERBERT OSBORN.
Publications Committee—F. O. GROVER, F. C. BLAKE, E. L. MOSELEY.
Library Committee—F. O. GROVER.
Committee on State Parks and Conservation—J. E. CARMAN, E. L. WICKLIFF, ROSCOE W. FRANKS.

Respectfully submitted,
R. V. BANGHAM, *Chairman,*
E. O. WEAVER,
G. W. CONREY,
HUGH M. RAUP,

List of New Members.

The following is a list of the persons whose applications were approved and whose election was recommended by either the executive or the membership committee and who were unanimously elected to full membership in the Academy at the business session on April 27, 1929, viz:

ARN, ELMER R., Dayton Clinic, Dayton. (*Medical Sciences*).
ASHCRAFT, ALVA, Leesville. (*Zoology, Botany, Geology*).
ASHCRAFT, D. W., Ohio State University, Columbus. (*Anatomy and Physiology*).
BAHER, DONALD L., 141 N. Professor Street, Oberlin. (*Geology, Geography and Physical Sciences*).
BAWMAN, DONALD, Orrville. (*Zoology, Medical Sciences*).
BENARD, RALPH N., Rising Sun. (*Botany, Zoology, Chemistry*).
BERGER, F. L., 121 E. Lehr Ave., Ada. (*Physics*).
BIRD, PAUL H., 121 Washington St., Delaware. (*Geology*).
BRACHER, GEO. J., 723 Woodlawn, Springfield. (*Medical Sciences, Zoology; Psychology; Physical Sciences*).
BRAND, LULU S., 2603 University Court, Cincinnati. (*Zoology and Botany*).
BROWN, J. B., College of Medicine, O. S. U., Columbus. (*Physiological Chemistry*).
BROWN, VIRGINIA R., 4419 Belmar Ave., Toledo. (*Biology; Eugenics*).
CAMPBELL, LIDA MAY, 5 Huffman Ave., Dayton. (*Biology*).
CARPENTER, FLOYD F., Roosevelt High School, Dayton. (*Zoology*).
CECIL, RODNEY, Agricultural Experiment Station, Geneva, N. Y. (*Entomology*).
CHURCH, MARGARET B., Urbana University, Urbana. (*Biology, esp. Botany and Mycology*).
CLARK, A. B., Zoology Department, O. S. U., Columbus. (*Biology*).
CULBERTSON, JAMES T., 420 S. Grand Ave., Ft. Thomas, Ky. (*Biology*).
EVANS, ARTHUR THOMPSON, Miami University, Oxford. (*Botany*).
EWERS, LELA A., Zoology Department, O. S. U., Columbus. (*Zoology; Anatomy; Physiology*).
FARIES, RUTH, Wittenberg College, Springfield. (*Zoology; Medical Sciences*).
GLOCK, WALDO S., Ohio State University, Columbus. (*Geology; Ecology*).
GRAHAM, WM. A. P., Department of Geology, O. S. U., Columbus. (*Geology*).
HARTSON, L. D., Oberlin. (*Psychology*).
HICKS, LAWRENCE E., Botany Department, O. S. U., Columbus. (*Botany; Ornithology*).
HOWLAND, JOS. W., Plain City. (*Zoology; Entomology; Anatomy; Medical Sciences*).
ILLICK, J. T., 2109 Adelbert Road, Western Reserve Medical School, Cleveland. (*Zoology*).
JONES, DAVID T., Department of Biology, Marietta College, Marietta. (*Zoology; Mollusca*).
JONES, GEORGE T., 322 West College Street, Oberlin. (*Botany; Ecology*).
JONES, HAROLD C., 352 W. College St., Oberlin. (*Ecology; Botany; Ornithology; Zoology*).
KECK, H. E., Athens. (*Zoology*).
*KOCH, BERTHE COUCH, Department of Fine Arts, O. S. U., Columbus. (*Psychology*).
LINK, J. A., 14 North Limestone Street, Springfield. (*Medical Sciences*).
LUTZ, DAN N., 1408 Clifton Ave., Springfield. (*Zoology; Chemistry; Botany*).
MAYER, CHARLES C. B., 1605 Hunter Ave., Columbus. (*Entomology; Botany*).
MCCARTHY, E. F., Central States Forest Experiment Station, O. S. U., Columbus. (*Forestry, and all sciences bearing on it*).
MCCLOUD, MARGARET, 192 Orchard Lane, Columbus. (*Nature Study*).
MCCLOY, JAMES H., 37 West Broadway, Westerville. (*Physics*).
MCGREW, JOHN B., 109 East Ward Street, Springfield. (*Physics; Chemistry; Biology; Astronomy*).
MEIER, A. H., 619 North Bever Street, Wooster. (*Zoology*).
METZLER, SIGMUND, 14 Cambridge Avenue, Dayton. (*General Science*).
*MILLER, AUGUST E., Urbana, Ill. (*Entomology, esp. Arachnida*).
MILLER, JOHN, Department of Zoology, O. S. U., Columbus. (*Zoology*).

MONTGOMERY, BLANCHE, 884 North Nelson Rd., Columbus.
PETERSON, ALVAH, Ohio State University, Columbus. (*Entomology*).
SCHOFF, STUART L., 168 N. Professor Street, Oberlin. (*Geology*).
*SHETRONE, H. C., Ohio State Museum, O. S. U., Columbus. (*Archaeology*).
SHUMAN, HELEN WOODBURN, Salesville. (*Geology; Psychology*).
SLEESMAN, GEORGE B., South Union Street, Ada. (*Botany; Entomology*).
SMITH, ISABEL SEYMOUR, 145 Woodland Ave., Oberlin. (*Botany*).
SQUIRES, H. D., Orton Hall, O. S. U., Columbus. (*Geology*).
STANNARD, J. NEWELL, 44 West Vine Street, Oberlin. (*Geology; Chemistry*).
STEPHENSON, BERNICE, University of Cincinnati, Cincinnati. (*Botany*).
STEPHENSON, HESTER, University of Cincinnati, Cincinnati.
STUPKA, ARTHUR, 66 West Tenth Avenue, Columbus. (*Nature Study*).
SWINGLE, MARY, Box No. 32, Philo. (*Biology*).
THATCHER, R. W., 140 Elm Street, Oberlin. (*Geology*).
TRACY, BERNICE G., Department of Bacteriology, O. S. U., Columbus. (*Bacteriology; Botany—Medical*).
TUCKER, FORREST G., 99 South Cedar Street, Oberlin. (*Physics; Mathematics; Chemistry*).
TWITCHELL, GEO. B., 845 Dayton, Cincinnati. (*Geology; Medical Sciences*).
WEED, R. B., 805 Buckeye Bldg., Columbus. (*Geology*).
WINSTON, MATTIE, 2626 Euclid Avenue, Cincinnati. (*Geology*).
WOLFE, RICHARD E., 108 East Maple Street, Clyde. (*Biology; Physics; Chemistry*).
WOLFRAM, GEORGE, 1507 Michigan Avenue, Columbus. (*Ornithology; Nature Photography*).
WUESTNER, HERMAN, 3335 Cavanaugh Avenue, Cincinnati. (*Mineralogy*).
ZURCHER, ESTHER R., 360 West Ninth Avenue, Columbus. (*Biological Sciences*).

* Reinstatement.

List of Deceased Members.

BENEDICT, HARRIS M. (Ex-President).....Cincinnati
BERRY, FRED.....Columbus
BOWNOCKER, JOHN A.....Columbus
COLE, A. D.....Columbus
MCFADDEN, L. H. (Charter Member).....Dayton

Report of the Committee on Resolutions.

SPRINGFIELD, OHIO, April 27, 1929.

To the Ohio Academy of Science:

Resolved, That the Ohio Academy of Science expresses its appreciation to the authorities of Wittenberg College and to the Local Committee for the facilities, privileges and entertainment provided during the Thirty-ninth Annual Meeting of the Academy.

F. C. WAITE,
S. R. WILLIAMS,
A. P. MATHEWS,
Committee on Resolutions.

Postscript: In response to the above Resolution, President Tulloss, of Wittenberg College, wrote the Secretary as follows, viz.:

SPRINGFIELD, OHIO, May 7, 1929.

MY DEAR MR. ALEXANDER:

We greatly appreciate your kindly letter of April 27th. This has been brought to the attention of our Prudential Committee.

It was a genuine pleasure to all of us to entertain the Acodemy.

Cordially yours,
R. E. TULLOSS, *President.*

The Scientific Sections.

The following is a complete scientific program of the meeting, viz.:

PUBLIC LECTURES.

Address of Welcome.....President R. E. Tulloss
Showing of the Canti Film with explanatory remarks....Dr. J. Paul Visscher
Presidential address on "The Distribution of Ohio Mammals,"
President James S. Hine
The American Eagle in Action by the use of a motion picture film,
Dr. Francis H. Herrick
The application of X-rays to the study of the structure of crystals, (**44**)
Frederick C. Blake

PAPERS.

(Numbers in parentheses after the title refer to abstracts).

1. Life challenges science.....David Dietz
2. S. P. Hildreth: Pioneer Biologist of Ohio.....H. R. Eggleston
3. Parasites of commercial fish of Lake Erie (1).....Ralph V. Bangham
4. Thermophylic (Heat-loving) bacteria including their distribution, methods of isolation and identification.....W. C. Beaver
5. Timing the codling moth spray for Ohio fruit growers (2).....T. H. Parks
6. Concerning Annelid "jaws" (3).....S. R. Williams
7. Some uses of Mallory's triple connective tissue stain.....A. W. Lindsey
8. On the systematic classification of the Naiades (4).....John C. Lotze
9. Ectoparasitic Infusoria of bait minnows (5).....Ralph V. Bangham
10. The explanation of electrotaxis in the earthworm.....W. M. Barrows
11. Nesting of the herons in Ohio.....Roscoe W. Franks
12. Observations on the micro-anatomy of a Parajulid diplopod.....R. A. Hefner
13. Methods used in culturing Copepoda and demonstration of some results obtained.....Lela A. Ewers
14. Some conditions influencing the formation of the epiphragm of the snail,
Walter C. McNelly
15. Some preliminary studies of Entomostraca of Lake Erie....J. Paul Visscher
16. Eggs from a virgin Polygyra thyroides (Say).....Walter C. McNelly
17. A preliminary survey of the fishes of Clark County, Ohio.....W. C. Beaver
18. The algal food of Pimephales promelas (Fathead minnows), (6),
Elizabeth E. Coyle
19. Insect Collecting in Porto Rico.....Herbert Osborn
20. Examples of orthogenetic evolutionary series in plants (7)..John H. Schaffner
21. Quantitative determination of yield as applied to forest plantations (8),
L. F. Kellogg
22. Primary vegetation types of Indiana.....Robert B. Gordon
23. Trypetheliaceae of North America.....Joyce Hedrick
24. Surveys in the upper Mackenzie Basin, N. W. Canada.....Hugh M. Raup
25. The physiological action of ultra-violet rays upon plants, Herbert C. Beeskow
26. The genus Wolffia in Ohio.....W. H. Camp
27. A so-called "Alkali Disease" of stock, due to plant poisoning,
Arthur T. Evans
28. The difference in sex-expression produced by increasing and decreasing photoperiodic gradients (9).....John H. Schaffner
29. Structure of some carboniferous plants.....J. Hobart Hoskins
30. Water loss from leaves in various conditions (10).....Glenn W. Blaydes
31. The vegetation of the Wood Buffalo Park.....Hugh M. Raup
32. Dry car-bruise of apples.....O. T. Wilson
33. The distribution of three Southern Pines in Ohio.....W. H. Camp
34. Announcement of plans for the annual field trip (11).....C. H. Behre, Jr.
35. Some features of the surface deposits of Ottawa County, Ohio (12),
G. W. Conrey

36. Physiography of the Pioche District, Nevada (13).....Lewis G. Westgate
37. A type of landslide common in clay terraces (14).....J. K. Rogers
38. The evidence in favor of Climatic differences during Ordovician and Silurian times (15).....A. F. Foerste
39. Conodonts of the Ordovician (16).....W. H. Shideler
40. The influence of the Canadian and Baltic shields of pre-Cambrian rocks on the distribution of the Ordovician and Silurian faunas of northern America and Europe (17).....A. F. Foerste
41. The Richmond group in the Nashville basin (18).....W. H. Shideler
42. The correlation of the silurian section of Adams and Highland Counties with that of the Springfield area (19).....A. F. Foerste
43. A study of some Devonian coral genera (20).....Grace A. Stewart
44. A new interpretation concerning the Hillsboro sandstone, (21), J. E. Carman and E. O. Schillhahn
45. The faunas of the Cumberland sandstone (22).....P. H. Dunn
46. Facies of the Borden rocks of southern Indiana (23).....P. B. Stockdale
47. Primitive characters of the fresh water bryozoans (24).....G. B. Twitchell
48. Outlines of the geology of Bermuda (25).....A. C. Swinnerton
49. The origin of the Middle Devonian cherts of Ohio (26)....Lewis G. Westgate
50. More exact geology (27).....G. W. Hubbard

50a. Some structural features in rocks induced by glacial movement (28), Waldo S. Glock

51. Marl balls of the Miami valley (29).....J. T. Rouse
52. Effects of compaction in coal-bearing strata (30).....E. M. Spieker
53. Some methods of correlation based on heavy mineral concentrates (31), W. A. P. Graham
54. Edge facies of mineralization at Leadville, Colorado (32)....C. H. Behre, Jr.

54a. Drainage modifications along the Blue Ridge (33).....Frank J. Wright

55. Sixty cases of Tularemia encountered in Dayton.....Walter M. Simpson
56. *The asthenic goitre syndrome.....W. F. Lauterbach and Francis Molz
57. The role of bile salts in body metabolism.....Shiro Tashiro
58. Production of gastric ulcer by bile salts and a means of inhibiting it, T. Tsuruta
59. Antagonism of the anti-coagulant action of bile salts by sugars, J. Jacob Kobes
60. The effect of feeding varying amounts of fish oil on the composition of the depot fat of the white rat.....J. B. Brown and S. G. Morris
61. Rickets in rats.....Alfred T. Shohl
62. The effect of raw and boiled yeast on the motility of excised rabbit intestine (34).....F. A. Hitchcock, J. B. Brown, and H. E. Hamlin
63. Correlative activities of the digestive tract in the domestic fowl (35), D. W. Ashcraft
64. The position of histidine in the protein molecule.....Garret J. Boone
65. The increase of toxicity of rattle snake venom by a blood-coagulant, W. M. Billing
66. Adrenalin and muscular fatigue (36).....R. J. Seymour
67. Familial pernicious anemia.....Stanley E. Dorst
68. Sexual differences in the blood of mammals.....Warren H. Reinhart
69. The blood pressure of the common Wood-Chuck (37).....Howard E. Hamlin
70. The function of the adrenal gland.....J. M. Rogoff
71. Silicosis in Ohio industries.....B. E. Neiswander
72. The role of iron in the oxidation of cysteine and its neutralization by cyanides.....Elmer G. Gerwe
73. A vitamin preparation in the treatment of diabetes (38).....C. A. Mills
74. Toxemias of pregnancy treated by magnesium sulphate and glucose, Andrews Rogers
75. Reticulocytes, their origin and significance, C. L. Spohr and Miss Alice Bustin

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* Owing to an oversight by the Vice-President of the Section, the authors of this paper were not informed that it had been placed on the program and so were not present to read it. It was read by title only.

76. Syphilitic myelitis following injection of arsphenamin, H. L. Reinhart and Ernest Scott
77. Unusual Echinococcus Cyst....Miss Margaret Oliver and Ernest Scott
78. Why do circles appear elliptical when seen in the Stroboscope? (39), W. K. Wilson
79. General adaptive behavior of idiots and pre-school children (40), Cecelia Gorsuch
80. Orientation in the earthworm (41).....A. R. Lauer
81. The psychogalvanic technique with children 11–17 years of age, H. A. Copeland
82. The technical vocabulary of the beginning student in psychology, (42), Horace B. English
83. Student superstition and the study of psychology (43).....H. C. Lehmann
84. Reports from the Ohio laboratories: Brief reports on investigations in progress: Informal.
85. The use of photo-electric cells for spectral line intensity measurements, A. F. Dittmer
86. The importance of crystal growth in colloid systems (45).....W. G. France
88. Formation and life of the metastable mercury atom (46).....M. L. Pool
89. A study of phenol disinfectants (47).....J. R. Harrod
90. A new C. T. R. Wilson cloud-expansion apparatus (48)....Gordon L. Locher
91. Free air-pressure maps as an aid in forecasting winds and weather conditions along airways (49).....Lloyd D. Vaughn
92. The return of the wandering water molecule (50).....W. H. Alexander
93. Motion of the ball on a bowling alley (51).....L. W. Taylor
94. Adjustable wall mountings for galvanometers and similar instruments (52), B. J. Smyth
95. Determination of e/m for the electron in the undergraduate laboratory (53), Forrest G. Tucker
96. Some applications of megneto-striction including a precise method of measuring the velocity of sound in air (54).....M. Grabau

DEMONSTRATIONS AND EXHIBITS.

1. Ecological variations as shown by Unionidae of Lake Erie and rivers of Ohio.....H. R. Eggleston
2. Preparations stained with Mallory's C. T. Stain. (Microscopes, preferably with mechanical stage, required).....A. W. Lindsey
3. Demonstration for Paper No. 3, General Session: Charts and Photomicrographs, Ralph V. Bangham
4. About 70 specimens of the fishes of Clark County, Ohio.....W. C. Beaver
5. Plants from the Mackenzie Basin.....Hugh M. Raup and Lucy C. Raup
6. A new method of recording psychogalvanic responses...Herman A. Copeland
7. Map showing the distribution of three pines (*P. virginiana*, *P. echinata*, *P. rigida*) in Ohio.....W. H. Camp

AUTHORS' ABSTRACTS

OF

SCIENTIFIC PAPERS AND DISCUSSIONS AT THE SPRINGFIELD MEETING, APRIL 26 AND 27, 1929.

All persons delivering addresses or presenting papers at the Springfield meeting were asked to prepare and submit abstracts of addresses and papers for publication in the Proceedings of the meeting. The following have been received by the Secretary in time for inclusion in this report. These are arranged by sections and numbered consecutively for convenience of reference.

A. THE SECTION OF ZOOLOGY.

DR. ANNETTE F. BRAUN, Cincinnati, Ohio, *Vice-President.*

1. *Parasites of Commercial Fish of Lake Erie.*—By RALPH V. BANGHAM, College of Wooster, Wooster Ohio.

This study was conducted for the Fish and Game Division of Ohio during the summer of 1928. Fish for study were obtained in the following ways: from experimental trap nets in the vicinity of Sandusky; from seine hauls at numbered stations along the Ohio shore to and including the Maumee Bay, along the Michigan shore of Lake Erie to the Detroit River; the vicinity of the Bass Islands; gill and pound nets of commercial fishermen along the Canadian shore and Ohio shore east of Peele Isle; from floating dead fish.

Five hundred fish from Lake Erie have been examined and the parasites identified. These fish belong to twenty-four species. Only the data from the fish of commercial importance are included in this paper.

A general discussion of the conditions with regard to disease and parasites is given. No correlation could be established between pollution and degree of infestation. In only a few cases were sufficient parasites found to cause serious damage to the host.

A study was made of the dead fish floating on the surface and on the shore line of Lake Erie during the latter part of July. The possible causes of this loss are discussed.

A brief summary of the parasites of the following species of commercial fish is given: whitefish (*Coregonus clupeiformis*); cisco (*Argyrosomus artedi*); sturgeon (*Acipenser rubicundus*); silver catfish (*Ictalurus punctatus*); common sucker (*Catostomus commersonii*); Carp (*Cyprinus carpio*); yellow pike (*Stizostedion vitreum*); blue pike (*Stizostedion glaucum*); sauger (*Stizostedion canadense griseum*); yellow perch (*Perca flavescens*); sheepshead (*Aplodinotus grunniens*).

2. *Timing the Codling Moth Sprays for Ohio Fruit Growers.*—By T. H. Parks, Ohio State University, Columbus, Ohio.

The time for application of the first cover spray is determined by: (a) daily emergence of moths in cages and from tree trunks kept under observation and where protruding pupa cases are removed daily; (b) keeping record of 6 P. M. temperatures suitable for egg laying.

3. *Concerning Annelid "Jaws."*—By S. R. Williams, Miami University, Oxford, Ohio.

Many Annelids have chitinous projections in the pharynx which serve either for holding or for rasping.

In almost all cases there is an introvert—a section of the buccal region which when everted will expose these jaws.

There are two types of jaws:

1. Those which are directly on the course of the alimentary canal (*Nereis* etc.).
2. Those which lie in a ventral eversible pocket (*Leodice*, etc.).

If we consider the everted position of the introvert as primitive these jaws must have developed from the chaetal pockets of the inturned segment or segments. These pockets typically would be 4, (aquatic Oligochetes 4 clumps of setae, Earthworm 4 double rows of setae. *Nereis* paired parapods each with notopodium aciculum and setae, neuropodium aciculum and setae).

Normally these would develop 4 jaws: two dorso-lateral, two ventro-lateral.

If in a ventral pocket, a dorsal set the maxillae, a ventral set the mandibles.

All sorts of modifications, by omission or addition, from *Stauro-cephalus* with a dozen maxillae to the Syllids with one dorsal median stabbing jaw.

4. *On the Systematic Classification of the Naiades.*—By John C. Lotze, Miami University, Oxford, Ohio.

A review of the more recent advances made toward a systematic classification of the Naiades (pearly fresh water mussels) showing the importance of the anatomical structures of the soft parts of the specimens in classification. The paper attempts to show the finer anatomy of the gills, arrangement of the ova and embryos in the marsupium, and structures of the edge of the mantle, all characters which are important in this classification.

5. *Ectoparasitic Infusoria of Bait Minnows.*—By Ralph V. Bangham, College of Wooster, Wooster, Ohio.

This paper is the result of studies concerning the serious loss of minnows by certain bait dealers. The short survey was conducted during the latter part of August, 1928 for the Ohio Fish and Game Division.

The losses and distress to the fish were attributed by the dealers to be due to the city water, but such was not found to be the cause. The

minnows were usually quite noticeably affected within 36 hours after they were brought in. There was a silvery sheen over the heads of many of the fish and the tails were white and frayed. There were large white areas where the skin was off. There was an increased mucus secretion. The sick minnows at first kept near the bottom of the tank and when very weak came to the top and died.

The conditions noted were caused by a mixed infection of *Cyclochaete* sp., and of *Chilodon cyprini*. The former is the larger and more active, but was not nearly as numerous as the latter parasite. The fish that were most heavily infested with these parasites when first brought into the tanks from the streams were stone roller (*Campostoma anomalum*), and common sucker (*Catostomus commersonii*). Temperature and crowding affected the spread of these forms. Control measures are discussed.

Another ectoparasite, *Ichthyophthirius multifiliis*, which affects minnows as well as other fish especially in the early spring when the water is cooler, is discussed.

6. The Algal Food of Pimephales promelas (Fathead Minnow).—By Elizabeth E. Coyle, College of Wooster, Wooster, Ohio.

In recent years increasing interest has been shown by icthyologists and those people concerned with fish culture regarding the food of our common fishes. The purpose of this paper is to describe the food of *Pimephales promelas* Rafinesque, the fathead minnow, giving special emphasis to the algal food, but also mentioning the animal forms and other materials found in the alimentary canal.

Pimephales promelas belongs to the mud-eating group of minnows. It feeds near the bottom taking in plant and animal food and organic remains along with large quantities of mud. Previous records tend to indicate that the fathead takes in more animal than plant food, but present observations show that animal food is proportionately less abundant than is the plant food. Of the animal forms observed, the Entomostraca were by far the most abundant. The other animal forms consisted of Rotifers, Nematoda, and the remains of a few small insects. Pieces of plant tissues were found rather frequently, but the algal material found in the alimentary canal is probably the only plant material which is used for food to any great extent. Two hundred three fish were examined and one hundred twenty-eight algal species and varieties were identified in the alimentary canals. It was found that the 128 species and varieties are distributed among the classes of algæ as follows: Myxophyceæ 34, Chlorophyceæ 63, Heterokonteæ 1, Euglenineæ 10, Peridinieæ 2, and Diatomeæ 18. *Pimephales promelas* does not appear to be nearly so much of an animal feeder as Kraatz has shown Pimephales notatus to be, neither is it so much of a plant feeder as is the gizzard shad which was studied by Tiffany in 1920.

B. THE SECTION OF BOTANY.

Dr. E. Lucy Braun, University of Cincinnati, *Vice-President.*

7. *Examples of Orthogenetic Evolutionary Series in Plants.*—By John H. Schaffner, Ohio State University, Columbus, Ohio.

All ordinary evolutionary movements give rise to orthogenetic series. Eight examples of this nature are considered and illustrated. The first represents an increasing differentiation between the foliage leaf and carpellate bract of species of *Abies*, beginning with *A. venusta* and ending with *A. lasiocarpa.* The second illustrates the evolution of the spikelet and its awn in the genus *Stipa* by 11 species, reaching from *S. macounii* to *S. pennata.* The third is the orthogenetic development of the little "horn" in the stamen appendages or coronahoods in the Asclepiadaceæ, shown by 6 progressive examples. The fourth represents an orthogenetic series of 7 stages resulting in over-adaptation in the development of a parachute on the achene, as illustrated in various groups of the Cichoriaceæ, running from *Sonchus* through *Lactuca* to the dandelion and salsify. The fifth series represents, by 8 stages, the peculiar movement which results in a flat vegetative system as illustrated by passing through a progression beginning with *Manfreda* through *Hymenocallis*, Iris, etc., to *Sisyrinchium graminoides.* The sixth series shows a progressive movement through 6 grasses, beginning with the two or three bristles present at the base of the pair of spikelets of *Chaetochloa verticillata* and ending in the elaborated bur of *Cenchrus palmeri.* The seventh series shows, by 5 stages, how an "alabaster box" to hold the spikelets and grain evolved by a continuous orthogenetic movement from *Andropogon furcatus* to *Euchlaena mexicana.* The eighth series represents the movement, in 12 steps, in a series of plants belonging to the mint family, of the perfection of a brush mechanism from a stamen. Beginning with a species like *Agastache scrophulariaefolia* with normal stamens and anthers, three special movements, (1) separation of the two halves of the anther, (2) rapid increase in size of the structures involved, and (3) progressive sterilization of the one half of the anther through the orthogenetic development of zygomorphy, bring about the remarkable pollen brushes with lever handles as are present in such extreme species of *Salvia* as *S. patens.*

8. *Quantitative Determination of Yield as Applied to Forest Plantations.*—By L. F. Kellogg, Assistant Silviculturist, Central States Experiment Station, Columbus, Ohio. (Introduced by E. F. McCarthy).

As a basis for the study there has been planted in the past in the Central States Region, an aggregate acreage estimated at 266,000 to 300,000 acres. Of this, about 14,000 acres is estimated for Ohio. The purposes of the study are two-fold: to secure data on the later success of plantations and to predict yield of planted species. Factors having special bearing on the volume of stands are site, quality, spacing, age, form, and injurious agencies.

The method of study involves (1) establishment and measurement of suitable sample plots, (2) computation of volume, (and the construction of volume tables) and (3) the statistical analysis of the data to correlate variables and secure curves of yield. The character of sample plots and data which are taken are discussed. A sample yield table is included to show the form and nature of data it contains.

A few slides illustrate forest plantations such as are studied and an exhibit contains instruments and forms used in sample plot work.

9. The Difference in Sex-Expression Produced by Increasing and Decreasing Photoperiodic Gradients.—By JOHN H. SCHAFFNER, Ohio State University, Columbus, Ohio.

Indian corn (*Zea mays*) was grown from successive plantings at the beginning and middle of the month from August 1 to April 15. It was found that although a deficiency in the length of daylight produces the same general effect, changing the tassel from maleness to partial or complete neutrality or to femaleness, yet when the corn was growing in a decreasing photoperiodic gradient, from a longer to a shorter day, the distribution of the various sexual tissues was different than when the photoperiodicity was increasing. Completely neutral tassels are produced only on a decreasing light schedule. No completely neutral tassels have appeared when the corn was growing in a lengthening photoperiodicity. Also, in the decreasing daylight of the autumn, femaleness develops only at the base of the tassel and its branches, the tips always being neutral with abortive spikelets, while on an increasing light schedule of the winter and early spring femaleness is sometimes expressed at the tips of the main axis and branches as well as at the base, with staminate spikelets between the two ends. There is sometimes also sporadic reversal on the tassel, the carpellate spikelets being distributed here and there among the staminate ones. These differences of expression in the decreasing and increasing photoperiodic gradients are to be explained with reference to the movements of the differentiation gradients in the inflorescence. In Indian corn, as in various other highly specialized plants the differentation does not follow the ontogenetic development of the axis and cell lineage, but the earliest flowers appear about the middle of the main axis of the inflorescence and its branches. From this point the blooming progresses in opposite directions toward the base of the apex. Thus it is evident that the upper part of the differentiation gradient of flower development goes hand in hand with the natural growth and determination gradient and the lower part moves in the opposite direction. Because of this, it follows that a changing photoperiodic gradient of the proper length of daylight to change the sexual states will result in different expressions in the tassel, depending on whether the light is increasing or decreasing.

10. Water Loss From Leaves.—By GLENN W. BLAYDES, Ohio State University, Columbus, Ohio.

Diurnal rates of water loss, as indicated by the standardized, cobalt chloride, hygrometric paper, have been obtained for 138 plants. This

group is made up of representatives of several associations; of the same species growing in several associations; comparisons of loss from leaves in different positions; comparisons of loss from young, mature and old leaves; comparisons of loss from a partial parasite (*Commandra*) and its host (*Vaccinium*), etc. In general, the maximum standard water loss is reached during the morning. Very young leaves, for those species tried, lose less water than mature leaves, and old leaves less than mature ones.

C. THE SECTION OF GEOLOGY.

Dr. Charles H. Behre, Jr., University of Cincinnati, *Vice-President*

11. The Proposed Field Trip of the Kentucky and Ohio Academies of Science, Geologic Sections.—By C. H. Behre, Jr., University of Cincinnati, Cincinnati, Ohio.

The field trip proposed is to start at Lexington, Ky., and study the Ordovician and higher rocks to the base of the Mississippian in the Eastern and Southern Blue Grass region. Subsequently, according to the original plans, the trip is to continue eastward into Kentucky, crossing the Pennsylvanian section and studying various economic features southwest of Ashland. Later the latter part of the trip was changed so as to carry it to Western Kentucky, where the crypto-volcanic structure at Jeptha Knob will be visited. Details of the trip were briefly discussed.

12. Some Features of the Surface Deposits of Ottawa County, Ohio.—By G. W. Conrey, Ohio Agric. Exp. Sta., Wooster, Ohio.

Ottawa County is entirely within the lake plain of northwestern Ohio. The surface is almost flat, except in the eastern part on the Marblehead Peninsula and the islands. The highest elevation is about 670 feet above sea level, so this area, following the withdrawal of the glacial ice, was entirely submerged during the early glacial lake stages. Beach deposits exist at elevations which correlate with the Wayne (660), Grassmere (640), and Lundy (620), beaches. During the Wayne and Grassmere stages Marblehead Peninsula existed as an island, and a small area on South Bass Island may have been just above water during the latter stage. During the Lundy stage, in addition to the Marblehead Peninsula, small areas were exposed on Catawba Island, South Bass Island, and Johnson Island. Beach deposits were laid down in favorable places. In the western part of the county, the southwestern corner was above water during Lake Lundy stage. The site of the beach is marked by a belt of very fine sand, which spreads out fan shaped on either side of the Portage River near Elmore. Southwest of the Lundy beach glacial drift is exposed at the surface; elsewhere in the flat part of the county the surface materials are slack-water deposits (silt and clay) varying in thickness from 3 to 10 feet or more.

13. Physiography of the Pioche District, Nevada.—By LEWIS G. WESTGATE, Ohio Wesleyan University, Delaware, Ohio.

Pioche lies in eastern Nevada, in the Great Basin region of faulted mountain blocks. The study of the district, just completed for the U. S. Geological Survey, shows no recent faulting but that the ending of diastrophic movements, including block faulting, has taken place early enough for the blocks to be reduced to maturity by Pliocene time.

14. A Type of Landslide Common in Clay Terraces.—By JAMES K. ROGERS, University of Cincinnati, Cincinnati, Ohio.

The premises here set forth are based on field studies of landslides in clays of the Hudson Valley, clay terraces of the upper Tonawanda and Limestone valleys in western and central New York, respectively, and the clay terrace of Licking River near Latonia, Kentucky.

Certain features seem to characterize this type of slide, which is developed typically in terraces of horizontally laminated clays, undercut by the lateral shifting of stream courses. The first manifestation of instability is bowing up at the toe of the slope. From a study of the profiles of the slides, it seems probable that this upward bulging is due to plastic or viscous flow at no great depth, rather than to the rotational movement of the mass which is apparent in the next stage.

The sliding is usually rapid, taking place along a curved surface or zone. There appear to be three main divisions of the landslide mass: (1) at the head, a down-slipped block or series of blocks, with surfaces tilted into the slope; (2) in the central part, a buckled and disrupted area, with wide fissures transverse to the direction of movement; (3) in the lower part of the slide, an anticlinal ridge or series of ridges, the foremost of which may be over-thrust and often occupies a part of the former stream channel.

15. The Evidence in Favor of Climatic Differences During Ordovician and Silurian Times.—By AUG. F. FOERSTE, Dayton, Ohio.

On account of the presence of corals in Arctic faunas it usually is assumed that polar climates were warm during Ordovician and Silurian times. However, we know nothing of the ability of early corals to adapt themselves to polar climatic conditions. They belong to entirely extinct divisions of the coral group, and may have had different life conditions in earlier times. On the other hand, the distribution of Ordovician and Silurian faunas lends itself more readily to explanation on the basis of a distribution in an east and west direction, than in a north and south direction. Thus there is a possibility that this distribution is in part due to climatic conditions, those forms farther north being better adapted to colder areas.

16. Conodonts of the Ordovician.—By W. H. SHIDELER, Miami University, Oxford, Ohio.

Although rarely observed, conodonts were fairly common in the Ordovician and include most of the dominant Devonian and Mississippian genera. Several species are described and figured.

17. *The Influence of the Canadian and Baltic Shields of Pre-Cambrian Rocks on the Distribution of the Ordovician and Silurian Faunas of Northern America and Europe.*—By Aug. F. Foerste, Dayton, Ohio.

Both the Canadian and Baltic shields are surrounded by Cambrian, Ozarkian, and Canadian strata, followed at greater distances by the higher Ordovician and Silurian. These shields are of such a large size that faunas passing across the Atlantic north of them become widely separated from those passing south of them. Such faunas as the Racine and various members of the Anticosti series of strata, which lie south of the Canadian shield, have their affinities with strata occurring south of the Baltic shield, but are not known to occur along the northern border of either shield. Migration of Racine faunas from Europe to America across the Arctic is highly improbable.

18. *The Richmond Group in the Nashville Basin.*—By W. H. Shideler, Miami University, Oxford, Ohio.

In the Goodlettsville region the basal division of the Richmond, the Arnheim, is followed by a few feet of unfossiliferous strata, and these by heavy limestones carrying a reduced Fernvale fauna, with no higher Richmond beds.

North of Gallatin the section shows the normal succession of the Cincinnati Province—Arnheim, Waynesville and Liberty, with no evidence of Fernvale. The Liberty fauna is that of the Bardstown Kentucky reef, much reduced.

Between Goodlettsville and Gallatin the Waynesville thins westward into the barren strata beneath the Fernvale, while the Fernvale thins eastward above the Waynesville. The position of the Fernvale in the generalized Richmond section is then at least post-Waynesville.

19. *The Correlation of the Silurian Section of Adams and Highland Counties with That of the Springfield Area.*—By Aug. F. Foerste, Dayton, Ohio.

In descending order, the Silurian strata of Highland and Adams Counties include the following formations: Peebles dolomite, Lilley formation, Bisher formation, Alger clay, Dayton limestone, Brassfield limestone, and an unnamed argillaceous formation related to the Edgewood formation of Missouri and southern Illinois. The Silurian section of the Springfield area includes: the Cedarville dolomite, Springfield dolomite, Euphemia dolomite, Massie clay, Laurel limestone, Osgood clay or argillaceous rock, Dayton limestone, and Brassfield limestone.

Of the rocks in Highland and Adams Counties the Peebles, Lilley, Bisher, and Alger are not known to occur in the Springfield area. The Peebles is equivalent to the Guelph of Canada, and therefore belongs above the Cedarville of the Springfield area, which is equivalent to the Racine of Wisconsin, the Racine being directly under the Guelph in that state.

The Bisher is equivalent to the upper part of the upper Clinton of New York, while the Euphemia dolomite is approximately equivalent to the Byron of Wisconsin. Between the Euphemia and the Bisher occur in descending order the Louisville limestone, the Waldron shale, and the Laurel limestone of Indiana.

Professor Orton used the name "West Union" for the Bisher in Adams and Highland Counties, and for the Euphemia in the Springfield area and in regions west of Springfield. The name West Union never was properly defined from any exposure near West Union. No fauna of a diagnostic character ever was listed by Orton from the West Union area, nor from Highland County. Orton's section at Hillsboro does not clearly indicate just how far upward his West Union at that locality extends. His use of the name West Union in areas farther north was incorrect, and for the sake of clearness it would be better if the term West Union were dropped entirely.

20. A Study of Some Devonian Coral Genera.—By Grace A. Stewart, Ohio State University, Columbus, Ohio.

A study now in progress on the corals of the middle Devonian rocks of Ohio has revealed the uncertain and inconstant use of generic names as applied to a number of Devonian genera. This paper discusses a few of these genera to illustrate the problems involved, and presents conclusions concerning them.

21. A New Interpretation Concerning the Hillsboro Sandstone.—By J. Ernest Carman and Ernest O. Schillhahn, Ohio State University, Columbus, Ohio.

A restudy of the Hillsboro sandstone of Highland County has shown that certain exposures, formerly interpreted as sandstone layers interbedded in the Greenfield and the Niagaran dolomites, are really masses of sandstone completely enclosed in the dolomites not more than 30 feet below the Silurian-Devonian disconformity, which here cuts across the Greenfield and Niagaran dolomites. The other exposures are of sandstone resting on either the Greenfield or the Niagaran at the horizon of the disconformity.

The Hillsboro is interpreted as including two types of deposits of the same age: (1) discontinuous sand deposits laid down on the post-Silurian eroson surface; (2) sand that was washed down into existing cavities beneath this eroson surface. The Hillsboro is younger than the erosoin interval which came after the formation of the Greenfield dolomite of late Silurian and older than the Ohio shale of Upper Devonian, which, in Highland County lies next above the Silurian-Devonian disconformity. It is in the same hiatus as the Sylvania sandstone of early Devonian age in northwestern Ohio.

22. The Faunas of the Cumberland Sandstone.—By Paul H. Dunn, Miami University, Oxford, Ohio.

There exists a rather interesting fauna in the Cumberland Sandstone, mostly ostracods, that may point to a possible relationship between that formation and the Saluda phase of the Upper Whitewater.

23. Facies of the Borden Rocks of Southern Indiana.—By PARIS B. STOCKDALE, Ohio State University, Columbus, Ohio.

Completion of three summers' field study of the Borden (Knobstone) group of Mississippian rocks in southern Indiana has revealed a stratigraphic situation with numerous complexities. The writer's work involved a connected study of the rocks from the Ohio River in southern Harrison Conty, northward to the glacial boundary in Morgan County, a distance of about 125 miles.

The Borden rocks, often correlated with the Waverly of Ohio, lie between the Rockford (Kinderhook) limestone and the Harrodsburg (Warsaw) limestone. They represent a sharply delimited stratigraphic unit of predominately clastic material. In the Ohio River localities, the group is about 500 feet thick, and in central Brown County it is 750 feet or more in thickness. Work of previous investigators has been incomplete and disconnected, and attempts to subdivide the group into stratigraphic units have been made only locally. The results are, therefore, not applicable thruout the entire outcrop area. The writer's studies reveal that the Borden group consists of five geological formations, each recognizable thruout the entire area. The formations carry sharply defined members which are locally traceable. In order of superposition the names of the formations, all but the lowest one of which are suggested by the writer, are as follows:

Edwardsville
Floyds Knob
Carwood
St. Joseph
New Providence

The chief source of confusion in the past has been the failure to fully realize that each formation displays numerous facies. There is much lithologic dissimilarity in a given formation between areas not widely separated. Perhaps the outstanding case is that of the Carwood formation which displays seven distinct facies over the 125 mile outcrop strip. In addition to the lithologic facies, faunal facies add difficulty to recognition of the different formations. The various facies have been appropriately named.

24. Primitive Characters of the Fresh Water Bryozoans.—By GEO. B. TWITCHELL, Cincinnati, Ohio.

Most of the recent marine bryozoans are too highly differentiated to be useful in determining the character of the organism that built up the fossilized zooecia of the Paleozoic bryozoans.

The fresh water bryozoans are usually considered as recent accessions to the fresh waters, but their simple, primitive structure suggests an old ancestry. The object of this paper is to present an account of these primitive characters and their relationship to the architecture of Paleozoic bryozoans.

The statoblasts (characteristic of many fresh water bryozoans) are usually considered a late adaptation to fresh water conditions,—i.e., frequent changes of temperature, dessication, and so forth. This

idea is emphasized by the fact that such resting bodies are also found in fresh water sponges and not in marine forms; resting bodies occur even in fresh water protozoa but not in the marine types.

An adaptation to fresh water conditions may not be the last word in accounting for statoblasts for statoblasts do occur (though rarely found) in marine Ordovician bryozoans.

The habit of growth of the primitive entoproct Urnatella, is very similar to that of the trepostomatous bryozoans of the Paleozoic. This is especially shown in the arrangement and characteristics of the immature and mature regions of a definitely segmented stem. There are no other living bryozoans whose structure approaches that of the Trepostomata so closely.

While these analogies are very suggestive, they cannot as yet be used for drawing more than tentative conclusions. More study is needed.

25. Outline of the Geology of Bermuda.—By A. C. Swinnerton, Antioch College, Yellow Springs, Ohio.

Volcanic activity was the first event in the history of Bermuda. Although no igneous rocks are found at the present surface, the volcanicity is known from the shape of the island mass and from the core of a well drilling. Erosion of the cone was possibly accompanied by slight subsidence. The following episode is represented by foraminiferal and fragmental marine limestones with some aeolian limestones, which together are called the Walsingham formation. Next in sequence occurred at least one period of uplift during which erosion produced a thick soil and initiated the present solution caverns. The Devonshire formation marks a thin marine overlap and is in turn followed by a complex succession of lightly cemented aeolian limestones and soils—the Paget formation of Verrill.

The age relationships are still uncertain, but there is the possibility that the physiographic changes represented by the sediments may be correlated with the Pleistocene glacial and interglacial episodes.

R. W. Sayles's investigations in Bermuda are contributing greatly to the knowledge and interpretation of the aeolianites and interbedded soils. The author's work on the Bermuda caves was an effort to reduce the known facts of change of level to a quantitative basis.

26. The Origin of the Devonian Cherts of Central Ohio.—By Lewis G. Westgate, Ohio Wesleyan University, Delaware, Ohio.

Recent publications by Tarr have held that cherts are contemporaneous gel formations on the ocean bottom. The study of the cherts of the Columbus and Delaware limestones indicate that they are replacements of limestones by silica after the deposition of the limestone but before uplift above sea level.

27. More Exact Geology.—By George D. Hubbard, Oberlin College, Oberlin, Ohio.

The author calls attention to the acoustic method for determining the form of the ocean floor. Each year also brings more accurate determinations of the distribution of salts and temperature in the sea,

which, when taken in connection with the calculations of depth, gives greater accuracy to the work of sonic depth finders.

Studies in sedimentation are very fruitful. Not long ago good geologists laughed at the idea that pebble shapes meant anything more than the kind or structure of the rock from which the pebbles came.

Once a tilted peneplain interpreted the topography of southern New England. Now measurements and carefully drawn profiles are showing that neither a tilted peneplain nor a series of plains of marine denudation fits the topography but several cycles of erosion with measured uplift between them.

Study of thin sections and of polished surfaces of metallic ores reveals so much more than could be seen in hand specimens, that economic geology is revising many of its conclusions. For example, the New Jersey zinc ores have been called igneous injections, bedded sediments remade, contact metamorphic deposits, and magmatic replacements, but the above more accurate methods of getting at the inmost relations of the minerals have shown that the deposits are metasomatic replacements in pre-Cambrian limestone, dehydrated and recrystallized by long continued, regional metamorphism before the arrival of Paleozoic time.

Let us work all areas of the world carefully and introduce thorough comparative studies. Let us measure and weigh, think and interpret again all in the interest of more exact geology.

28. *Some Structural Features in Rocks Induced by Glacial Movement.*—By Waldo S. Glock, Ohio State University, Columbus, Ohio.

In northeast Columbus the upper beds of an exposure of shale were found crumpled against a wall of undisturbed shale in such a fashion as to suggest that the position and deformation resulted from shove by the ice front. An overturned fold and two thrust faults in the squeezed materials indicate a strong eastward component in the ice movement. An illustration of asymmetrical folds in gravels induced primarily by ice drag is given for purposes of comparison.

29. *Marl Balls of the Miami Valley.*—By John T. Rouse, University of Cincinnati, Cincinnati, Ohio.

When Huffman Dam, a part of the Miami Conservancy Project for the prevention of floods in the Miami Valley, was constructed on the Mad River 4 miles northeast of Dayton, excavations were made in the valley to obtain gravel for use in building the dam. As a result of these excavations a lake, one-half mile long and one-quarter mile wide, was formed on the west side of the river above the dam.

Along the nearly vertical shore, five feet below the flat valley floor and continuous around the lake, is a layer of gravel incrusted with marl. In extreme cases small pebbles form the centers of large porous marl balls 16 to 18 inches in diameter.

In the discussion a more detailed description of the marl balls and their occurrences is given, several papers dealing with similar studies are reviewed, and an attempt is made to show that these represent deposition, in situ, around pebbles in an extinct lake.

30. *Effects of Compaction in Coal-Bearing Strata.*—By Edmund M. Spieker, Ohio State University, Columbus, Ohio.

Irregularities in coal-bearing strata are commonly due to differential subsidence or uplift or both, with resulting differential deposition, and perhaps also erosion, of both coal and other sediments. Differential compaction may be another important factor, particularly in local irregularities. If the transformation of peat from the time of burial to the stage of bituminous coal involves the amount of compaction commonly agreed upon by students of coal, then the lateral juxtaposition of peat and sand or clay, in situations such as channels, abrupt ends of swamps, and other places where peat growth or accumulation was irregular, ought to result in considerable differential compaction and consequent stratigraphic irregularity. The results of such differential compaction are of importance to the geologist in the study of (1) closely spaced columnar sections of coal-bearing rocks; (2) "wants," "horsebacks," and some of the similar types of cutout in coal beds; (3) splits, particularly those which develop in short horizontal distance; and (4) any abrupt thickening or thinning of a coal bed.

Study of "wants" in coal beds of Utah led the writer to a consideration of differential compaction as a factor in the history of coal measures, and the present paper is essentially a progress report on an investigation which is extended to include observations in other widely spaced coal fields. Examples of "wants," splits, and columnar sections are cited to show what appears to be the effect of differential compaction, and the importance of the phenomenon in some short-range correlation of coal beds is suggested.

31. *Some Methods of Correlation Based on Heavy Mineral Concentrates.*—By Wm. A. P. Graham, Ohio State University, Columbus, Ohio.

Correlation of sedimentary rocks on the basis of contained heavy minerals is not always satisfactory. The percentage of the various heavy minerals is usually the only feature used. Four methods of heavy mineral correlation were used and compared in the study of the four Croixian formations of Minnesota. The isotropic and anisotropic minerals, garnet, tourmaline, zircon, apatite, anatase and cyanite were used. The opaque grains, such as pyrite, magnetite, and ilmenite, were not used in correlation, since they are frequently very badly weathered, making positive identification difficult.

The correlative methods tried were (1) the percentage of each mineral in the individual heavy crops, (2) the number, mineral variety and associations of inclusions in the heavy parts of each formation, (3) the shapes of the grains in each crop, and (4) the texture of each heavy mineral species in each formation.

The results show it is not possible to use the first three methods for correlating these formations, but the fourth method is usable if several samples from the same formation are available for study. There is considerable variation in the percentages of the heavy minerals in samples from the same formation making it necessary to study several samples from each formation before attempting correlation.

32. Edge Facies of Mineralization at Leadville, Colorado (Presented by permission of the Director of the U. S. Geological Survey).—By Chas. H. Behre, Jr., University of Cincinnati, Cincinnati, Ohio.

The main ore bodies of Leadville, already repeatedly described, are of the "blanket" replacement type. The center from which the ore-bearing solutions radiated was apparently the Gray porphyry stock at Breece Hill, with its associated high temperature minerals; the greater part of the mineralization of the district, however, is mesothermal.

Studies in Iowa Gulch, five miles east of Leadville, show eastward decrease in the amount of Gray porphyry intrusions, with corresponding differences in mineralization. Whereas manganosiderite and chalcopyrite are at least important constituents near Breece Hill, the ores in Iowa Gulch are almost free from both but bear relatively larger quantities of galena, sphalerite, and barite. In form the Iowa Gulch ore bodies are never well-developed blankets, though structural conditions are similar to those at Leadville; they are fissure fillings or replacements immediately against the walls of fissures, the latter type suggesting solutions more dilute than those at Leadville.

The sphalerite of Iowa Gulch is light-colored, in contrast with the uniformly darker zinc blend that occurs nearer Leadville.

This comparison furnishes another instance of ore zoning. It also favors the inference, already tentatively advanced by others, that light-colored sphalerite has travelled farther than the darker varieties. The Iowa Gulch deposits represent a peripheral or edge facies of the more intense and higher temperature mineralization at Leadville.

33. Drainage Modifications Along the Blue Ridge.—By Frank J. Wright, Denison University, Granville, Ohio.

A study of the headwaters of the Linville, Broad, and Green Rivers in western North Carolina. Although the Blue Ridge is a westward migrating divide, only a few streams have been diverted from westerly to easterly courses. The changes in these streams have been effected since the close of the second (Asheville) cycle. The upper portions of their drainage basins still preserve the Asheville level, which rises at some points to within two hundred feet of the older or Upland level.

D. THE SECTION OF MEDICAL SCIENCES.

Dr. Albert P. Mathews, University of Cincinnati, *Vice-President.*

34. The Effect of Raw and Boiled Yeast on the Motility of Excised Rabbit Intestine.—By F. A. Hitchcock, J. B. Brown and H. E. Hamlin, Ohio State University, Columbus, Ohio.

The effects, if any, of yeast on the gastro-intestinal tract have recently been much discussed largely on account of claims made for yeast by commercial yeast companies. We have investigated the

effects of both raw and boiled yeast using the method originally described by R. Magnus (1904). We find that raw yeast when present in concentrations of 0.5 to 2.0 grams per hundred cc. of solution has a marked inhibiting effect causing a cessation of motility as well as a pronounced drop in tonus. This effect is often slightly delayed and may then be preceded by a period of fifteen to thirty seconds during which the tonus is increased. Boiled yeast in similar concentrations has almost exactly the opposite effect. The tonus of the intestinal strip is increased to a marked degree and often the motility is increased. The increase in tonicity is usually preceded by a very temporary decrease in tonus. If the suspension of yeast is perfused through the lumen of the intestine concentrations ten times as great as those noted above produce no effect at all. Many other substances produce similar effects. Aqueous extracts of the gut wall, of baked beans, of clover and asparagus act similarly to boiled yeast, all showing a stimulating effect. We were unable to verify the conclusions of Polansky who reported that it was the vitamin B content of the yeast that produced the action on the intestine.

35. Correlative Activities of the Digestive Tract in the Domestic Fowl.—By D. W. Ashcraft, Ohio State University, Columbus, Ohio.

Comparing, by various methods, the activity of the crop of the normal bird with that of the decerebrate bird, no appreciable differences were observed. Further study of the decerebrate bird reveals that no material difference in crop movements occur before and after incising the skin and fascia over the crop and esophagus. A fistula through skin and crop with balloons in situ did not alter its activity. Hunger contractions of the crop invariably result in restlessness of the bird. Less frequently thirst and defecation are factors which also cause restlessness. The form of the curve of contraction by the balloon method, show that the type of contraction of the gizzard is variable, depending upon the position of the balloon in the cavity of that organ. In hunger, the proventriculus and gizzard are vigorously and continuously contracting.

36. Adrenalin and Muscular Fatigue.—By R. J. Seymour, Ohio State University, Columbus, Ohio.

Experiments were carried out to test the possible effect of adrenalin in relieving and preventing muscular fatigue. Ergographic records taken until complete fatigue occurred, followed by 5 minute rest intervals showed no effect when adrenalin was injected intra-muscularly at the beginning of a rest period. In other experiments adrenalin (½ to 1 cc. of 1 : 1000) injected intra-muscularly had no effect whatsoever upon the fatigue curve. Similar experiments were tried, giving adrenalin (2 cc. of 1:1000) thru the sublingual lymph spaces. These likewise were ineffective in the prevention or relief of fatigue.

37. The Blood Pressure of the Common Wood-chuck.—By H. E. Hamlin, Ohio State University, Columbus, Ohio.

The blood pressure of a male wood-chuck, caught February 3, 1929, was measured by the standard mercurial manometric method. This animal had come out of hibernation, and the measurements were made March 11, 1929. It was kept under ether-urethane anesthesia throughout the experiment. The blood pressure measurements were made from the carotid artery. The normal mean arterial pressure varied from 108 mm. to 126 mm. Hg., which compares favorably with other mammals. The normal pulse rate under these conditions varied from 180 to 204 beats per minute. Faradization of the vagi and crural nerves brought about reactions from the cardio-vascular mechanisms similar to those obtained from other mammals. Likewise adrenalin (1 cc. to ½ cc. of 1:50,000) caused characteristic rises in blood pressure and increases in pulse rate.

38. The Treatment of Diabetes Mellitus with a Plant Extract Rich in Vitamin "B."—By Clarence A. Mills, M. D., Department of Internal Medicine, University of Cincinnati, Cincinnati, Ohio.

It was found that an acid-alcoholic extract of plants rich in Vitamin "B" greatly stimulated the appetite and growth of children and warded off upper respiratory infections. Since insulin is used in diabetes to stimulate the burning of glucose and thereby stop infections, it was thought advisable to try the vitamin extract in diabetes. Several cases, studied in Peking, China, showed a prompt disappearance of sugar from the urine, and a stabilization of the blood sugar at levels near normal, when given the extract. These cases were reported last year*. This winter it has been tried on several patients in Cincinnati, with definite results, although not so striking as were obtained in China. It rarely fails, however, to eliminate the infections, which are the bane of diabetics, and to give added strength and vigor.

The study is being carried on to ascertain the full *value of such treatment.*

E. THE SECTION OF PSYCHOLOGY.

Dr. Samuel Renshaw, Ohio State University, *Vice-President.*

39. Why Do Circles Appear Ellipitical When Seen in the Stroboscope?—By W. K. Wilson, Ohio State University, Columbus, Ohio.

Explaining the horizontal shortening of figures seen in the stroboscope has been an interesting problem in the psychology laboratories for many years, and many theories have been advanced as to the probable cause of this phenomenon. The most prevalent among these has been the theory that the shortening is due entirely to the speed of the drum in which the figures are revolving.

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* Amer. Jour. Med. Sci., 1928, 175, pp. 376.

The writer denies the validity of this claim, assigning the cause of the shortening to other factors entirely independent of the speed of the drum. His theory is that "with the size of figure, diameter of drum, and width of slit constant, the amount of shortening varies with the distance of the eye from the edge of the drum." This theory as stated applies to the cylindrical stroboscope, with figures and drum revolving as a unit, and the figures viewed on the side of the drum opposite the slit, so that slit and figures are moving in opposite directions.

The proof of this theory was set forth in the following manner: A circular piece of paper representing the drum was pivoted with a pin on a piece of cardboard, with the figure 'f,' the slit 's,' and the eye E marked in their respective positions. The ends of 'f' were marked 'k' and 'l,' 'k' being the end first appearing through the slit to the eye at E, and 'l' being the last appearing end. 'K' was designated as the initial point and 'l' as the terminal point. The edges of the slit were marked 'm' and 'n,' 'm' being the edge first to arrive at a given point under counter-clockwise rotation.

The drum was rotated to the position where 'k,' 'm' and 'E' formed a straight line. At this position 'k' was just appearing to the eye at E. The location of 'k' was marked as a_1 on the cardboard at the edge of the drum. Then the drum was rotated further to the position where 'l,' 'm' and 'E' formed a straight line. At this position 'l' the terminal point, was just appearing to the eye; the position of 'l' was marked b_1 on the cardboard. The arc a_1b_1 was then demonstrated to the arc be within which the entire figure 'f' could be seen from 'E.' Although the entire figure was seen within the arc a_1b_1, it is only for very small values of 'd' that the whole figure is seen at any one instant. Instead, it is seen in a series of successively appearing parts,—the size of those parts again depending upon the value of 'd.' With the drum rotating at a rate known as the optimum rate these parts are merged by the after-image effect into a unitary figure and the brain receives the impression of a complete figure.

Using small 'e' to designate the arc a_1b_1, 'r' the radius of the drum and 'd' the distance of the eye from the nearest edge of the drum, 'e' may be calculated for varying values of 'd' by the formula:

(1)

$$e = \left[\sin^{-1}\left\{\frac{r}{r+d}\cdot\left(2\sin\frac{f}{4}\cdot\cos\frac{s}{4}\right)\right\}\right] + \frac{f}{2}$$

where 'f' is the horizontal length of the stroboscopic figure (the diameter, in the case of circles), and 's' is the width of the slit. The linear values of these may be used as angular dimensions in the formula and then 'e' may be read directly as a linear dimension although mathematically it is an angular dimension.

Next the drum was set again with 'k' at a_1 then rotated until 'k,' 'n' and 'E' formed a straight line. At this position, marked a_2, 'k' was just passing out of vision, having been constantly in vision throughout the short arc a_1a_2. By similar procedure it was shown that every detail at 'f' is visible IN MOTION under an arc equal to a_1a_2, and it is

this seen motion through a short arc that produces the blurred edges of the stroboscopic figures.

Although for ordinary distances of the eye from the drum ('d' values) all of the figure 'f' is not visible at the same instant, the maximum amount is visible when the slit 's' is directly in front of the eye. The formula for calculating the size of the arc 'v' which is visible with the slit so located was derived as:

(2)

$$v = 4\left[\tan^{-1}\left(\frac{2.91}{d}\right) + 1.25\right]$$

for the apparatus used at Ohio State University, where the drum radius equals 134 millimeters and the slit width equals 5 millimeters.

Curves from formulæ (1) and (2) were plotted on the same axes and were found to intersect at a point close to the y-axis. Between this point and the y-axis lie all values for 'd' for which 'v' (formula 2) is equal to or greater than 'f.'

40. General Adaptive Behavior of Idiots and Pre-School Children.—By Cecelia Gorsuch, Ohio Wesleyan University, Delaware, Ohio.

The work with chimpanzees by Kohler, Yerkes, and others, together with the ever growing interest in the pre-school child suggested the comparison of these two groups with that third type of intelligence, the idiot. A group of ten idiots from the Training School at Vineland, N. J., ranging in mental age from eighteen months to four years, were used in experimental situations as nearly as possible like those Kohler reported on in *The Mentality of Apes.* The study is being carried further by presenting the same situations to ten normal children between three and four years of age.

Kohler found evidences of "insight" in the solutions of problems by chimpanzees. The same type of behavior was noted in the case of idiots and has been observed in the present experiments on normal children. The language of human subjects offers a means of interpreting some of their reactions. This is especially true in the idiot group because of the slight inhibition of language habits. An idiot and sometimes a normal child while looking for a stick will talk about a stick almost constantly.

Many characteristics of primate behavior as reported by Kohler are evidenced in the reactions of normal subjects as well as a few striking differences. These differences may be a matter of physical development, training, potentiality for further growth in the case of normal children, or a fundamental difference in the type of intelligence of the three groups.

These experiments are by no means conclusive owing to the limited number of subjects and the difficulties encountered which called for a constant revision of technique and adaptation to normal subjects. Certain differences and similarities are, however, manifested; the type of which may be observed, but the reasons for which are at present merely speculative.

41. Orientation in the Earthworm.—By ALVAH R. LAUER, Ohio State University, Columbus, Ohio.

Various authors have reported learning in the earthworm with relatively short periods of training. The present study was originally undertaken to determine conditions which might affect the rate of learning. Because of failure to procure the expected results the study raises a number of theoretical questions relative to learning since it has been assumed that the earthworm can be conditioned. While these data will not invalidate the findings of other workers, they suggest that possibly some of the so-called learning of invertebrates is not learning in the strict sense of the term.

Five worms were used at the beginning of the experiment. These worms were isolated and kept in an ice-chest registering around 2° C. Also fifteen control worms were kept in a container in the same place.

A T-maze made of ¾ inch glass tubing was used with electrodes in each turn such that the current could be reversed, or changed from side to side. The lighting conditions were kept as nearly constant as possible but to check the effects of lateral stimulation the control group were put through the maze at each series of trials for the experimental worms. Again, there is reason to believe that a worm will follow its own or another worm's mucous trail. To off-set this factor the experiment was begun by running each experimental worm only three times and following it by another worm which was being conditioned to go in the opposite direction. This was made feasible by the reversible feature of the maze.

However after the usual number of trials in which learning was reported there was no statistical evidence of learning whatsoever and after more than 350 trials (about twice as many as other investigators have secured—nearly perfect conditioning) we have no evidence of learning such a maze.

The worms were run over a period of seven weeks, being kept at a constant temperature, carefully fed, and all precautions taken to guarantee accuracy in results. The data are presented as evidence of the difficulty of conditioning the earthworm in problems requiring orientation to the right or left. Also there is further evidence that the control worms tended to follow the trail of the worm that preceded it altho the total right and left runs showed a chance distribution.

42. The Technical Vocabulary of the Beginning Student in Psychology Together With a Note on the Statistics of Reliability.—By HORACE B. ENGLISH, Antioch College, Yellow Springs, Ohio.

Summary. A vocabulary test devised by C. L. Harlan was given to a group of 37 students at Wesleyan University (Conn.) and of 35 students at Antioch. Results were compared with those published by Harlan.

Antioch was superior to Wesleyan by small but statistically significant amounts, more particularly in the lowest quartile; and both these groups were so strikingly superior to the Idaho groups tested by Harlan that distinct teaching techniques would seem to be called for.

Neither at Wesleyan nor at Antioch was there a significant correlation between grades in psychology and the vocabulary test nor between the test and standard measures of general intelligence. The student comment that standing is determined merely by one's memory of vocabulary is not sustained.

The validity of the Spearman-Brown prophesy formula is submitted to empirical test, using the Vocabulary Test as material. It is shown to lead one to expect, in most cases, a considerably higher consistency between one testing and another than in fact is found.

The concept of reliability is critically examined, and somewhat more exactly formulated as the extent to which a measure is unaffected by chance factors intrinsic to the measuring instrument. Spearman's measure of reliability is rejected as presupposing conditions which can never be known to be fulfilled.

It is proposed to utilize the familiar random-halves correlation as a true measure of reliability as above defined.

The difference between random-halves correlation and the correlation of two "comparable" tests is suggested as a measure of the effect of extrinsic factors upon re-test consistency.

43. The Prevalence of Certain Misconceptions and Superstitions Among College Students Before and After a Course in Psychology.—By Harvey C. Lehman, Ohio University, Athens, Ohio.

The writer in collaboration with Dr. Norman Fenton attempted to discover the prevalence of certain misconceptions and superstitious beliefs among two groups of college students; the first group, students entering their first course in psychology, and the second group, students who had successfully completed a course in elementary psychology and also approximately three-fourths of a course in educational psychology. Supertitious belief was found to persist rather generally among the students who had studied psychology. The writers suggest that several class periods in general psychology be devoted specifically to discussion of the more common superstitious beliefs. It is unsafe to depend upon wholesale transfer of training to overcome the student's weakness for phrenology, fortune-telling and various other forms of occultism. A judicious class program in the first course in psychology will involve: (1) Identification of the student's most glaring superstitions by means of the familiar pre-test technique, and (2) direct and specific attack directed toward their elimination.

F. THE SECTION OF PHYSICAL SCIENCES.

DR. E. H. JOHNSON, Kenyon College, *Vice-President*

44. The Application of X-Rays to the Study of the Structure of Crystals.—By FREDERICK C. BLAKE, Ohio State University, Columbus, Ohio.

1. After briefly describing how crystals are made up of layers of atoms and illustrating this idea with lantern slides, some of the ways of studying crystal structure were spoken of and illustrated, stress being laid upon the powder method and the rotating crystal method.

2. Various illustrations were given of the powder photographs obtained for pure metals, and for alloys and other crystals, and the question of the actual interpretation of the powder photographs was discussed in a general way with illustrative material.

3. The application of the rotating crystal method to the study of organic compounds and to such crystals as can be obtained in the macro-state was made, with some very interesting illustrative material.

45. The Importance of Crystal Growth Colloid Chemistry.—By W. G. FRANCE, Ohio State University, Columbus, Ohio.

Recent investigations employing the "powder" method of X-ray crystal analysis have established the fact that in many colloid systems of the suspensoid type the dispersed phase is made up of ultramicroscopic crystals possessing lattices identical with those of the massive materials. This fact suggests that the crystallographic fields of force effective at the contact of the various crystal faces and the dispersion medium should be a factor in determining the extent of the adsorption process and likewise the degree of stability of the colloid system. One would therefore expect the magnitude of these forces to be dependent upon the crystallographic structure of the various faces, those made up of ions of like charge being greater than those made up of a mixture of like and unlike charges. Several investigators have used this explanation to account for the modification of the crystal habit of sodium chloride when grown in the presence of urea. To further test the validity of this explanation and also to determine the magnitude of the adsorption effects the growth ratios $\frac{[100]}{[111]}$ of the macroscopic crystals of ammonium and potassium alums grown in the presence of various dyes and amino acids were measured by a motion picture method. In all cases in which the foreign material was adsorbed, the adsorption took place preferentially in favor of those faces populated by ions of like charge. The normal growth ratios were therefore reduced. Measurements and calculations of the thickness of the adsorbed layer indicate that in the case of ammonium alum and diamine sky-blue the layer is "less" than monomolecular in thickness. The results of this work indicate that the adsorption is dependent upon (1) residual valencies; (2) polar groups in the adsorbed materials and (3) the interionic distances in the crystal lattice.

46. Formation and Life of the Metastable Mercury Atom.—By M. L. Pool, Ohio State University, Columbus. Ohio.

The formation of large numbers of 2^3P_0 metastable states in mercury vapor at room temperature without at the same time the formation of measurable quantities of other excited states may be effected by using (a) optical excitation to the 2^3P_1 state with 2737 A and (b) collisions of the second kind of this state with nitrogen or water vapor. The amount of absorption of 4047 ($2^3P_0 — 2^3S_1$) in the excited mercury vapor indicates the concentration of the metastable states. Measurement of the absorption for various time-waits in the neighborhood of 10^{-4} seconds after the interruption of the exciting radiation show that the state decays exponentially with time. The maximum life (or maximum half value time) of 4.2×10^{-4} sec. was observed for 6.8 mm. of admixed nitrogen. Extrapolation to zero nitrogen pressure gives a "natural life" of 7×10^{-4} sec.

47. A Study of Phenol Disinfectants.—By J. R. Harrod, Ohio Northern University, Ada, Ohio.

The purpose of the study is:

1. To investigate the effect of various concentrations of sodium hydroxide in the analysis of phenol disinfectants.

2. To compare the method of analysis developed by W. H. Chapin with the method developed by J. Bennet Hill and to discover, if possible, the reason for discrepancies in the results given by the two methods.

When these disinfectants are treated with sodium hydroxide, sodium phenolate is formed, but equilibrium is established before the reaction is complete if only equivalent quantitives are used. An excess of sodium hydroxide is therefore added to prevent this. A concentration more dilute than 1:6 is unsatisfactory.

The discrepancies in the results of the two methods are due to the fact that the specific gravity of the free phenols and disinfectants are not considered in the final calculations.

48. A New Large C. T. R. Wilson Cloud Expansion Apparatus.—By Gordon L. Locher, Miami University, Oxford, Ohio.

A large C. T. R. Wilson cloud apparatus, which is operated by simply turning a crank, has been built especially to study paths of x-ray photo-electrons in gases. The apparatus is a modification of the Shimizu-Wilson machine and has the advantages of a large cloud chamber combined with the speed and simplicity of operation of the small reciprocating type. The timing of all operations associated with the production of the tracks is automatic.

An investigation of the successive photo-electric action of x-rays, first observed by Auger, is being undertaken. This involves the examination of a great number of stereoscopic photographs of the tracks with a stereo-comparator.

49. Free-Air Pressure Maps as an Aid in Forecasting Winds and Weather Conditions Along Airways.—By LLOYD D. VAUGHAN, Junior Observer, U. S. Weather Bureau, Columbus, Ohio.

In the observations regularly taken at all first order Weather Bureau stations the observed readings of the barometer are first corrected for variations in temperature, local gravity and station elevation, and also for certain errors which are inherent in the instrument itself; so that when the sum of all of these corrections is applied to the observed reading, the result gives the true local or station pressure, i.e., the pressure produced by the weight of the air column situated above that point.

After determining the station pressure it is necessary to reduce this to very nearly the value it would have if the air column should be extended on downward for a length corresponding to the height of the station above mean sea-level. This reduction is carried out by means of a solution of the hypsometric equation, the temperature argument being derived from the mean of the current dry temperature and the dry temperature obtained at the observation taken twelve hours previously.

In actual practice, each station has an appropriate table upon which is given the sea-level values for any station pressure corresponding to each five degrees difference in the mean temperature. The use of this table, of course, makes for much greater convenience and the saving of time in working up the observation.

When these values are collected from all parts of the country and set down upon the sea-level map, the differences thus shown between one place and another then appear as actual differences in atmospheric pressure reduced to one homogeneous horizontal plane, and are not differences due to variations in altitude etc., between the different stations.

It happens, however, that in spite of all of the advantages that it may have, the sea-level map does not often give us a very definite idea as to the actual distribution of pressure and the resultant gradients and wind movements in the atmosphere at a height sufficient to be free of many local surface variations. It is well known that local differences in temperature and the effect of surface friction and turbulence have a very great influence in modifying what might otherwise be a more nearly true representation of conditions aloft.

It has been noted, too, that the location of the center of an area of high or low pressure area is not geographically the same on the sea-level map as it is on a chart showing the pressure distribution at a height of 1 or 2 kilometers and this shift in the location of the center and the consequent trend of the gradients as shown on the upper air map may sometimes provide the only possible indication of what changes may be expected to occur within the next 24 to 36 hours.

So that from the forecaster's standpoint the free-air map may furnish a solution of some of the difficulties involved in correctly interpreting the conditions shown on the sea-level map, besides indicating certain existing conditions which the surface map does not show.

The point which is of particular interest in connection with the airways service, however, is that on the upper air map the *wind direction is along or parallel to the isobars** and the velocity, of course, will be indicated by the steepness of the gradient in that locality; whereas on the surface sea-level map, the friction and turbulence occasioned by the movement over this surface causes the wind to blow *across the isobars at an angle* and local irregularities may also cause the direction of the indicated surface wind to be entirely misleading in indicating what the wind movements are aloft.

A further advantage is that if the free-air maps are found to be entirely dependable in giving accurate information as to the direction and velocity of wind movements occurring in the upper air, it will bring about a considerable saving in the expense which would otherwise be necessary for maintaining a greater number of pilot balloon stations for the purpose of obtaining this same information by direct observation.

This investigation into the methods of charting pressures in the free-air is an attempt to continue some of the work of the late Dr. C. L. Meisinger, who by his wonderful genius and industry had already accomplished so much toward the solution of this extremely difficult problem, when his brilliant career was so untimely terminated by his tragic death in a balloon accident early in 1924.

The reduction of pressures to the 1 and 2 kilometer levels limits these maps to the central and eastern portions of the country only; as the elevation of many of the stations in the western plateau region is much higher than 1 kilometer, and moreover, the barometry of this region presents a very much more complicated and difficult problem than that of the plains and the eastern part of the field; but it is hoped that later, as this work progresses, it will be possible to extend the reductions to higher levels and to draw free-air maps for the entire United States and southern Canada.

The essential basis of the present work is to reduce the pressures from the station values up to the 2 kilometer level, instead of downward to the sea-level plane, and for convenience in this reduction process, use is made of a graphical device which is here called a "Pressure Reduction Nomogram."

A temperature correction is necessary in order to obtain the mean temperature of the air column through which the reduction is made, and the index giving the value of this correction, Meisinger found was directly related to the surface wind direction.

It was not possible to obtain the values for all the station pressures in the construction of the charts which accompany this article, but it was found that an approximation sufficient to illustrate their value and interest in connection with the air-ways weather service could be had by reducing directly from the sea-level pressures to the 1 and 2 kilometer planes, the temperature argument being the current A. M. dry temperature and both the pressure and temperature values being taken from the daily telegraphic signal reports.

*Assuming a stationary formation and a steady state of adjustment between gradient and wind.

50. The Return of the Wandering Water Molecule.—By WILLIAM H. ALEXANDER, Senior Meteorologist, U. S. Weather Bureau, Columbus, Ohio.

The escape, the wanderings and the return of the water molecule constitute one of the longest and one of the most fascinating stories in the vast realm of modern meteorology. These molecules are escaping ceaselessly into the atmosphere in inconceivable numbers and quantity and form one of its most vital elements. It is estimated that, for the world as a whole, sixteen million tons of these molecules enter the air every second. While they escape, in the main, singly, they return in great crowds, or groups, or masses.

It was proposed in the few moments given to this paper to discuss briefly, and, by the use of the lantern slide, indicate some of the interesting and more or less well-known forms in which these molecules return to earth from their wanderings, such as the raindrop, the dewdrop, the snow flake, sleet, hail, rime, glaze, frost, etc. In this way some of the marvelously interesting things revealed by the microscope regarding these visitors from cloudland were pointed out.

51. Motion of the Ball on a Bowling Alley.—By L. W. TAYLOR, Oberlin College, Oberlin, Ohio.

This is an experimental study of the motion of the ball on a bowling alley. A recording device registers to hundredths of a second the times of passage of the ball through successive half-meter intervals. The ball is launched by a catapult instead of by hand, in order that the initial velocity may be controlled. The ball passes from an initial sliding motion to final rolling. Systematic deviations from behavior prescribed by the simple theory suggest the way in which the transition occurs from sliding friction to rolling friction.

(This paper is published in full elsewhere in this report.—W. H. A.).

52. An Adjustable Wall Mounting for Galvanometers and Similar Instruments.—By B. J. SMYTH, Oberlin College, Oberlin, Ohio.

A simple wall mounting has been devised for supporting instruments which require delicate levelling. The mounting has a slow-motion levelling adjusment about both horizontal axes. The device was on exhibition.

53. Determination of e/m for the Electron in the Undergraduate Laboratory.—By FORREST G. TUCKER, Oberlin College, Oberlin, Ohio.

The method is a modification of that suggested by H. Busch, Phys. Zeit., 23; 438; 1922. A low voltage a. c. source is connected to one pair of deflecting plates of a Western Electric Cathode Ray Oscillograph. The straight line trace on the screen is then reduced to a point by means of a uniform longitudinal magnetic field. The equation for e/m is derived by elementary analysis.

54. *Some Applications of Magnetostriction Including a Precise Method of Measuring the Velocity of Sound.*—By MARTIN GRABAU, Wittenberg College, Springfield, Ohio.

This paper comprises a review of the recent researches of Professor G. W. Pierce of Harvard University together with a report upon unpublished and uncompleted work on the application of Magnetostriction to the problem of measuring the velocity of Sound to a greater precision than has hitherto been attained. The minute change in length of a magnetic rod upon being magnetized is utilized to control the frequency of a vacuum-tube oscillator very much after the manner of the Piezo-electric crystal. This phenomenon leads at once to many precise methods for frequency control and measurement. Inasmuch as the length of the magnetostrictive rod varies periodically its face becomes the source of a Sound wave. If this Sound wave is directed against a reflecting surface the returning wave will either aid or oppose the vibration of the rod according to phase difference between the two vibrations. This reaction is observable and yields an accurate measure of the wave-length of the Sound when the reflector is moved along by means of a precision screw. This method is an extension of Professor Pierce's previous experiment involving the reactions on a Piezo-electric crystal source.

THE MOTION OF A BALL ON A BOWLING ALLEY.

DR. L. W. TAYLOR
Professor of Physics, Oberlin College, Oberlin, Ohio

A number of years ago the writer had occasion to work out the theory of the motion of a homogeneous sphere on a plane, with friction. Some of the results invited experimental work. Access to a bowling alley, normally idle during the summer vacation period, recently made this possible.

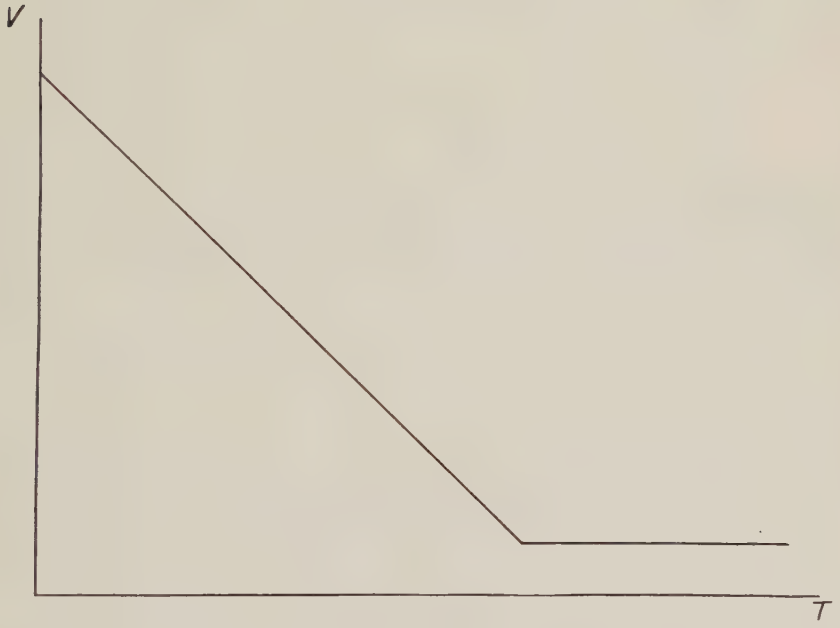

FIG. 1. Theoretical Velocity-Time Relation.

What may be termed the "simple theory" for present purposes, shows that a sphere, projected as described, subject to constant frictional force, ultimately ceases sliding and thereafter executes a motion of pure roll. The transition from sliding to rolling occurs, if the initial projection was without rotation, at the instant that the velocity of the center of the ball becomes five-sevenths of the initial velocity. This is entirely independent of the value of the coefficient of friction.

Furthermore, the time elapsed and the distance travelled when this stage is reached may be expressed by the relations:

$$t = \frac{2v_o}{7a} \quad \text{and} \quad s = \frac{12v_o^2}{49a}$$

respectively, where v_o represents the initial velocity and a the acceleration of the ball.

The velocity—time relation should be straight line up to the point where pure roll sets in. Rolling friction being not measurably different from zero, the velocity is constant from this point on. A discontinuity in the transition from sliding to rolling motion is implied by our assumption of constancy of the coefficient of friction. (See Fig. 1).

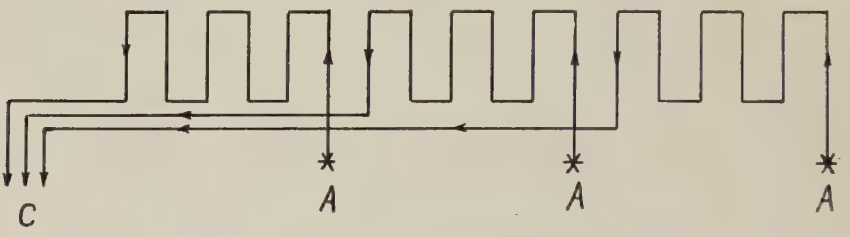

FIG. 2. Arrangement of Arcs (A) and Camera (C) and Course of Light Beams.

These conclusions were subjected to test as follows: A beam of light was reflected back and forth across the alley at a level just below the top of the ball, thence into a camera which carried a moving film, the speed of the film being about ten cms. per second. Every passage of the ball through the beam produced a break in the otherwise continuous line traced by the stationary spot of light on the moving film. More than thirty reflections were involved in the optical system. Since the loss at each reflection was such as to limit us to twelve reflections, the optical system was divided into three parts, with an arc for each part as shown. (See Fig. 2).

The use of sixty-cycle alternating current on these arcs produced one hundred twenty extinctions per second, thus providing a time scale on the film. (See Fig. 3). The section of film shown here illustrates the way the observations were recorded. The interval between successive dots represents one one hundred twentieth of a second, while that between the

successive larger extinctions of the line represents a fifty-centimeter travel of the ball, fifty centimeters being the distance between the mirrors along the alley.

That initial velocities might be reproducible, the ball was launched by a catapult rather than by hand. This consisted of a pendulum swinging on ball bearings, holding the ball in a three-point suspension. (See Figs. 4 and 5). Delivery of the ball was effected by retarding the pendulum with a spring

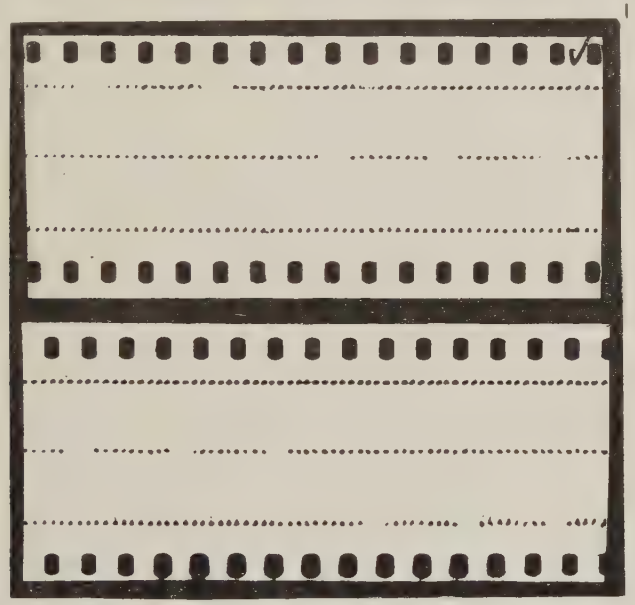

FIG. 3. Sections of Film, bearing typical records.

as it reached its lowest point. A slow-motion adjustment of the length of the pendulum made it possible to deliver the ball tangent to the alley, without audible impact.

Some five hundred records were taken, about equally divided between ten different velocities. The velocity-time relation for seven of these is shown graphically herewith. (See Fig. 6). The two higher velocities placed the transition point beyond the range of our optical system, and hence are not included here, and the lowest velocity is excluded because it reached the transition point before yielding sufficient information concerning the acceleration while sliding.

Qualitatively these curves are not far different from that of the simple theory. Quantitatively there is considerable

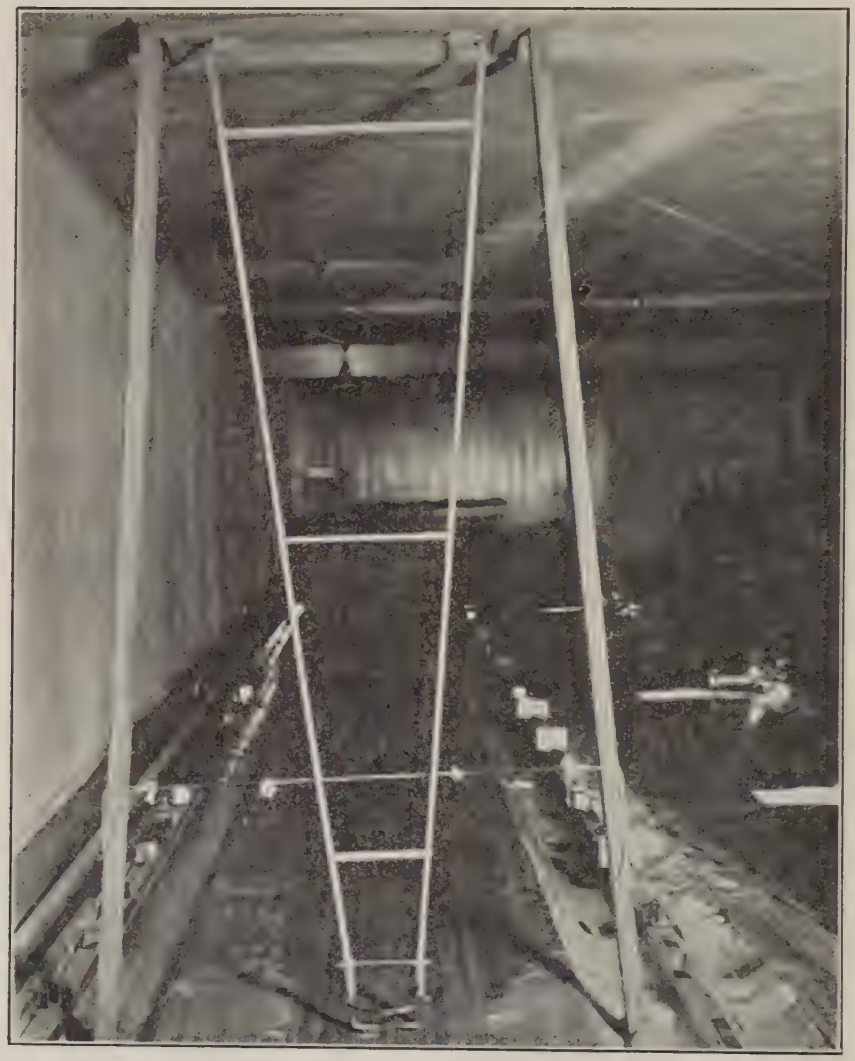

FIG. 4. Catapult. Alley in background; arcs at right.

difference. The passage from sliding to rolling is gradual instead of abrupt, which was really to be expected. This "smoothing out" of the knee of the curve indicates a departure

of the frictional force from constancy. The departure begins to be evident when the relative velocity of the sliding surfaces

FIG. 5. Method of Launching Ball by Catapult.

becomes less than about sixty cms. per second. But for the law of this departure, we have insufficient information. The establishment of a sufficient number of points on the knee of

the curve would require observations at intervals considerably smaller than the diameter of the ball. This would require an experimental method entirely different from the one used.

The first point of each curve represents the average velocity over the first fifty cms. of travel; therefore, presumably an approximation to the instantaneous velocity twenty-five cms. from the starting point. The actual initial velocity we can only infer by producing the curve back to the velocity axis,

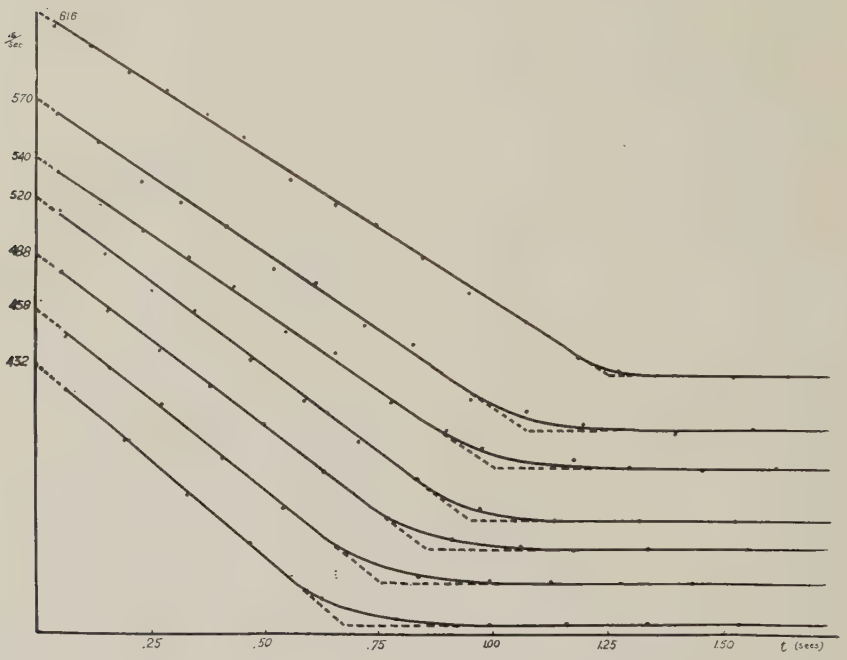

FIG. 6. Velocity-Time Grafs, for different initial velocities.

as shown by the dotted line. This procedure may not be justified. There is some evidence that the friction at the outset is less than that along the larger part of the course. By dusting the alley with lycopodium powder, we found that if the ball was launched by hand, rather than by the catapult, its motion was one of bouncing rather than sliding for nearly if not quite the full length of the alley. The bouncing could not be entirely eliminated by even the most careful adjustment of the catapult, though it could be confined to a region of less than twenty-five cms. at the beginning of the course. That

the average effective friction was the same for the bouncing motion as for the sliding would be a decidedly questionable assumption. There is reason to believe that it is less. In that case the worst possible situation would be zero friction, or the initial velocity approximately equal to the velocity at twenty-five cms. The effect of such an assumption we shall observe in a moment.

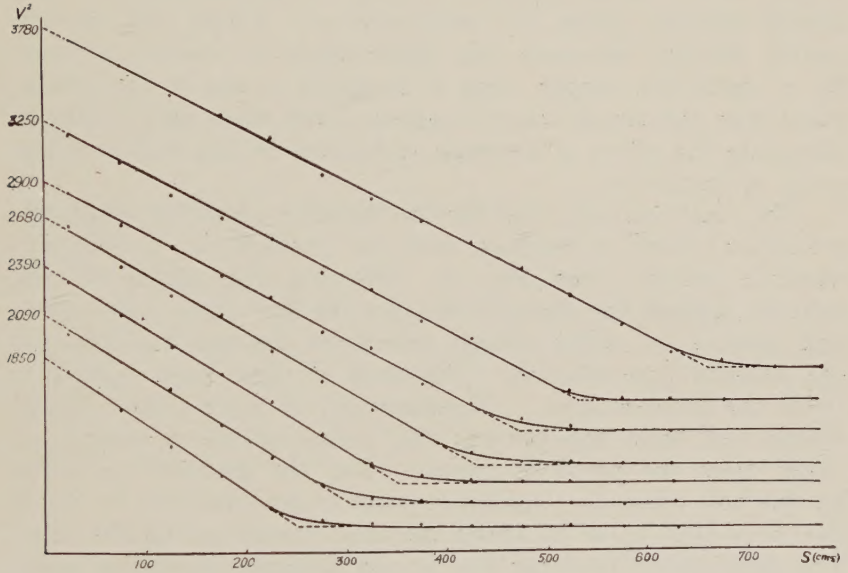

FIG. 7. Velocity-Distance Grafs, for different initial velocities.

The observations give the *final* velocities quite definitely. The simple theory indicates that this final velocity should be five-sevenths of the initial, regardless of the friction. The observations, using the extrapolated value of the initial velocity, place the final velocity consistently three percent lower than the theoretical value. But using the average velocity over the first half-meter as the initial velocity as suggested above, the observed final velocity is higher than the theoretical by two percent. This suggests that the initial velocity is less than the extrapolated value but greater than the average velocity over the first half-meter of travel, a conclusion not at all startling. In other words the final velocity constitutes the most reliable basis for estimating the initial.

The departure from constancy on the part of the coefficient of friction in the region of transition from sliding to rolling renders any test of the other two relations rather inconclusive. Such a test might be made by noting the point of intersection of the dotted extensions of the two straight portions of the curve, a familiar though usually questionable expedient. In this case it yields results which average nearly seven percent higher than the theoretical, basing the calculations on the initial velocity given by extrapolation. Using the smaller initial velocity increases this discrepancy to twelve percent. So a definitely longer time is required to reach the rolling state than the simple theory suggests, even when we attempt to eliminate the effect of decrease of friction in the region of the point of transition.

The final relation, that for the distance travelled when the transition point is reached, may be checked by a velocity-distance graph. (See Fig. 7). Plotting the *square* of the velocity against the distance rectifies the first part of the curve and gives a set which closely resembles the previous one for the velocity-time relation. The slope of these lines represents twice the accelerations. Measurement of these slopes checks within less than one percent the values of the accelerations taken from the previous curves. But the distance travelled by the ball when the transition point is reached fails to check the theoretical value by about the same margin as did the time. The discrepancy is either five or ten percent, depending upon the choice of initial velocities.

We have seen that the value of the coefficient of friction appears to gradually decrease at velocities less than sixty cms. per second. How it decreases we cannot say, except that it appears to vary continuously from that for sliding to that for rolling friction. From sixty up to the maximum of about six hundred cms. per sec., shown in the preceding curve, there is no clear evidence of variation of the coefficient of friction with velocity. The value is not quite the same for different curves, possibly due to the fact that the catapult was moved sideways several times to avoid wearing channels in the alley. In the two high-initial-velocity curves not shown, up to seven hundred cms. per sec., there was unmistakable indication of a larger slope at the beginning than subsequently. The information on the departure from constancy of slope at the beginning

is even more meager than for that at the end. At present all that can be said is that for the velocity range of sixty to six hundred cms. per sec., the coefficient of friction between the composition known as "mineralite" and varnished wood, parallel to the grain is .18, though there is clear evidence that it changes both above and below this range.

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